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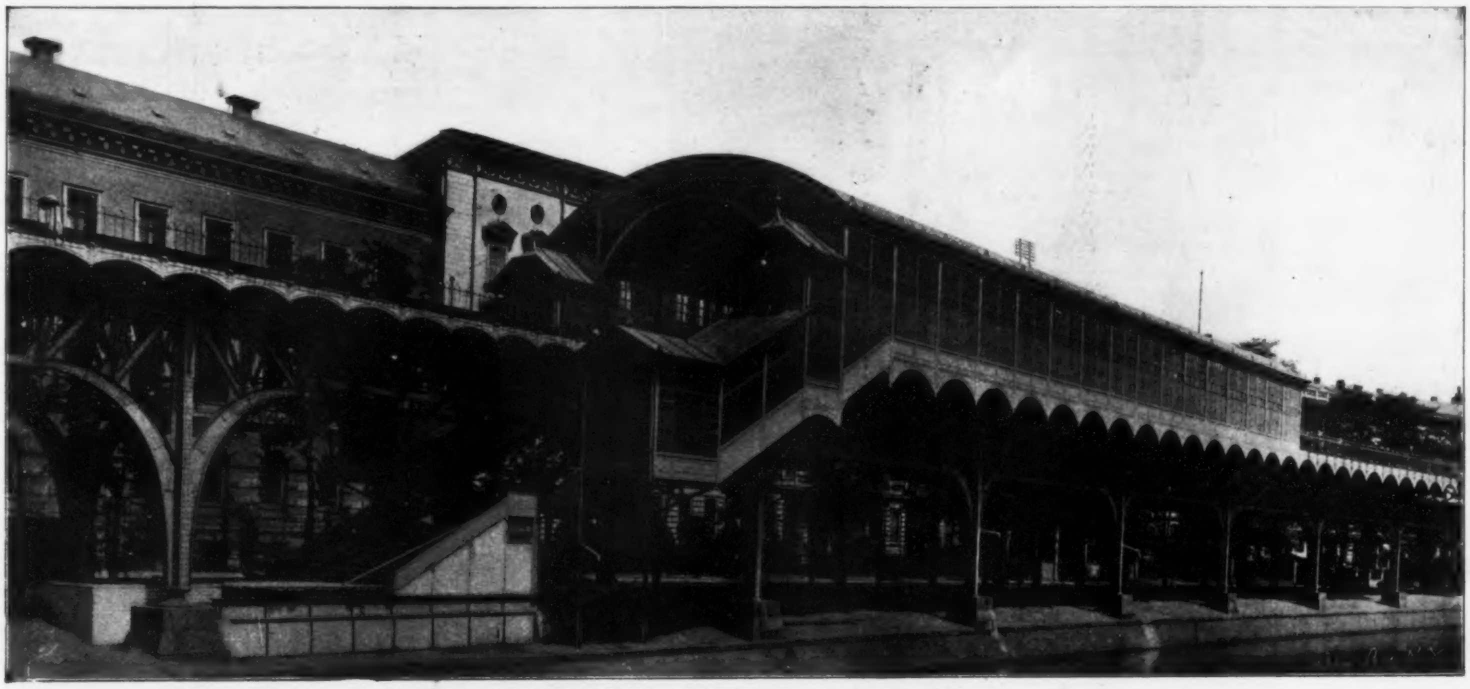
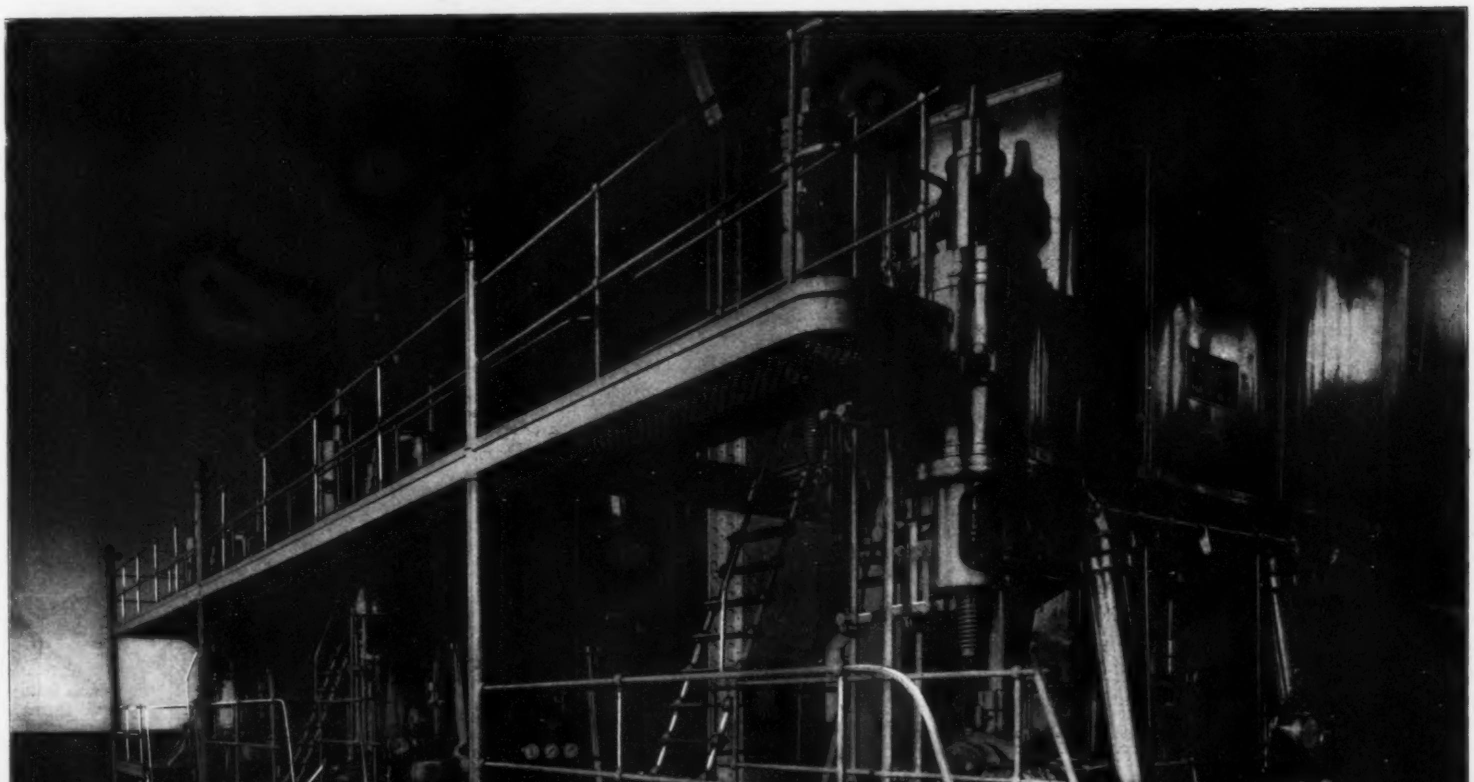


THE ELEVATED RAILWAY STATION AT THE MÖCKERN-BRÜCKE.



ENGINES OF THE POWER STATION OF THE BERLIN RAILWAY.

THE BERLIN UNDERGROUND AND ELEVATED RAILWAY.—II.

[Continued from SUPPLEMENT No. 1400, page 22431.]

THE UNDERGROUND AND ELEVATED ELECTRIC RAILWAY IN BERLIN—NOW COMPLETED AND IN OPERATION.*

By FRANK C. PERKINS.

EACH shunt-wound dynamo has a capacity of 800 kilowatts and supplies a continuous current at a potential of 750 volts. The floor of the dynamo room is somewhat lower than that in the engine room proper, and all of the parts of the generators which require attention are within easy reach. The two floors are connected, as seen in the accompanying figures, by staircases.

The main switchboard, which is constructed of marble panels, is erected on a platform slightly elevated from the floor, and is connected to the generators by heavy iron armored and lead-covered cables, and from the switchboard the current is conducted to the feeders. The mountings of the main switchboard are the usual switches, fuses and circuit breakers for the generators and feeder panels, as well as the necessary ammeters and voltmeters required.

A small auxiliary switchboard is provided for connecting the main switchboard to the booster and storage battery used for regulation and lighting. The storage battery has a capacity of 1,200 ampere hours, and a small auxiliary dynamo or motor generator is provided for raising the potential necessary in charging. The storage battery used for regulation and reserve, as well as the lighting battery of 20 volts potential, which may be charged by the booster, are placed in adjoining rooms in the three arches of the overhead railway viaduct. The booster and battery is also used for driving the auxiliary electric motors used at the plant.

It will thus be seen, from the accompanying illustration, that the power house is so arranged that the basement is utilized for the pumps, condensers and mechanical auxiliaries; the first floor is used for the engine room, generator room and switchboard as well as repair shop, and the top floor for the boiler equipment, coal bunkers, superheaters, and ash and coal conveying apparatus.

At the side of the building facing the yard there is provided a chimney about 80 meters or 262 feet high, of which only about 65 meters or 213 feet is effective, owing to the position of the boilers at the top of the building.

The diameter of the chimney at the top is somewhat less than 4 meters; and as the boilers are about 15 meters above the ground, and the lower portion of the chimney cannot be used for providing draught, it is utilized for other purposes. The lower part of the chimney is divided into two floors, one of which is used as a storeroom and the other as closets, washrooms and dressing rooms for the staff, being near the repair shop of the engine room.

The power house was designed by D. Wittig, one of the directors of the company. The writer is indebted to the firm of Siemens & Halske and the Gesellschaft für Elektrische Hoch- und Untergrundbahnen for the data, photographs and drawings presented in this article.

The contact or third rails on the electric railway lines are placed on the right-hand side of the line in the tunnels and on the left-hand side on the elevated structure. The conductor rails are a trifle more than a meter from the center of the track, and are raised about half a foot above the running rail on the elevated portion and still higher within the tunnel, and thereby the automatic lighting of the cars in the tunnel is made possible.

The third rails are about 12 meters or 40 feet long and have a cross section of 3,600 square millimeters (5½ square inches). They are ordinary iron rails connected by copper bonds at the joints and insulated by vulcanized rubber supports bolted to the superstructure at intervals of about 6 meters (19 feet). On the elevated lines the conductors are protected by timber, but not in the tunnel.

The main feeders are made of copper strip placed on edge, and they have a cross section of from 1,000 square millimeters to 1,500 square millimeters (1½ to 2½ square inches). The conductors for lighting the various overhead and underground stations vary in size from 10 square millimeters to 150 square millimeters, the drop being calculated not to exceed 100 volts on the lighting circuits.

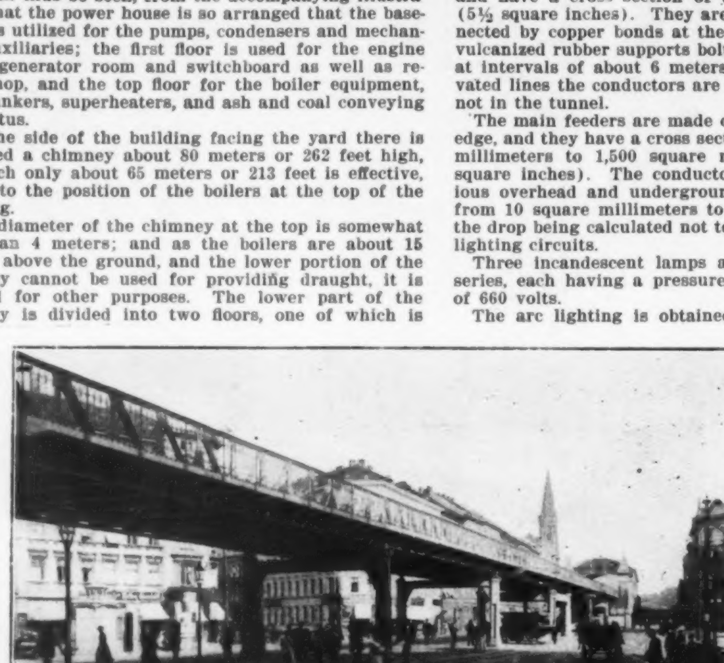
Three incandescent lamps are usually employed in series, each having a pressure of 220 volts or a total of 660 volts.

The arc lighting is obtained by the use of twelve lamps in series, each having a potential of 55 volts, and a compensating device is provided at the power station for taking care of the fluctuations.

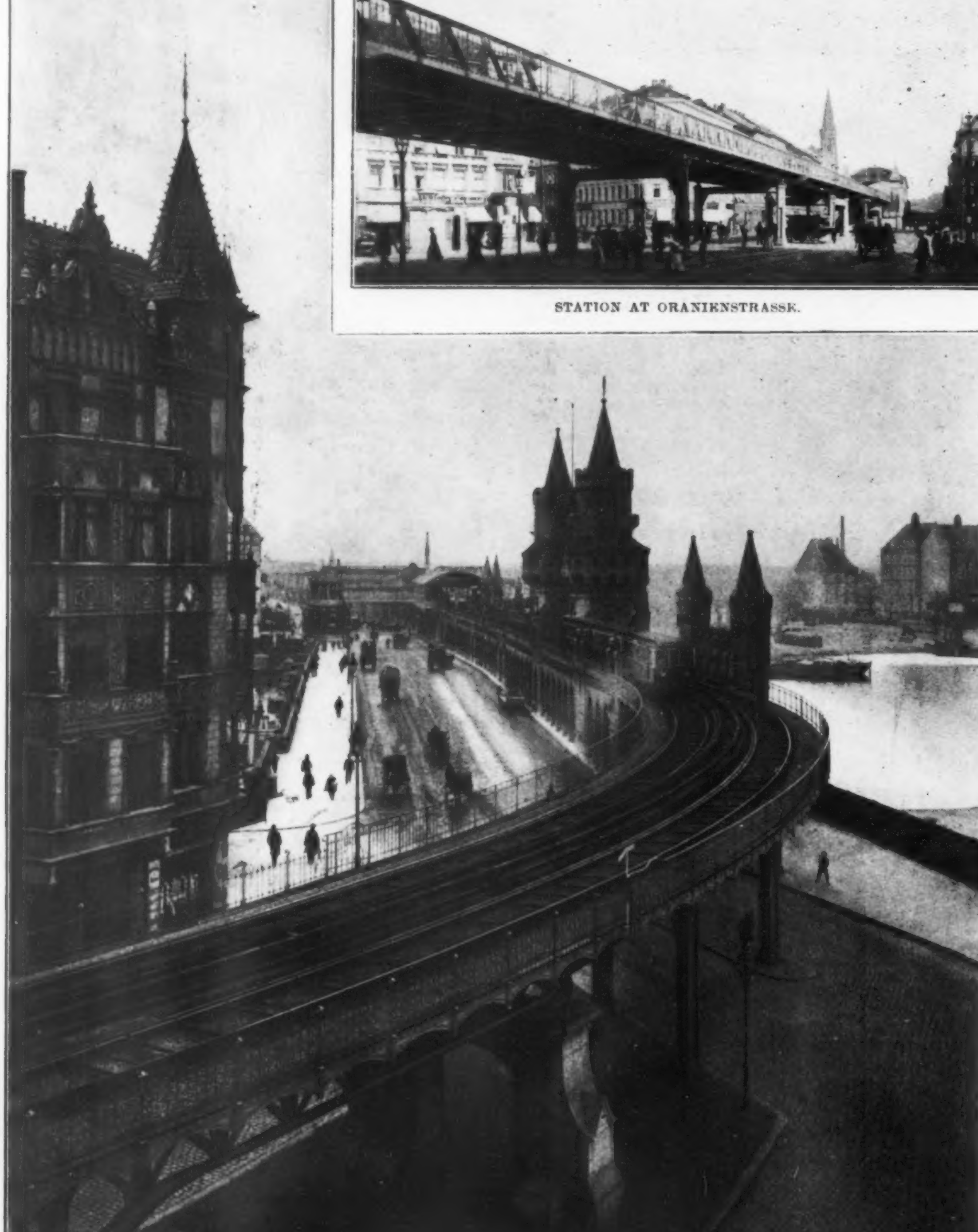
The trains weigh 80 tons loaded and consist of three cars, the first and last being motor cars, which are equipped with single reduction motors operating at a potential of 750 volts. The current varies from 900 amperes to 1,500 amperes. Each of the four axles is connected to a motor, and the motors are geared to drive the train at 30 kilometers per hour.

The train is made up of two third-class cars and one second-class car, the latter being of a red color and supplied with upholstered seats running lengthways of the car on either side of a central aisle. There are also two folding seats in the second-class car, one at either end, while the third-class cars have a single folding seat and inclosed vestibules for the motormen.

There are two doors arranged for entrance and exit, the passenger always passing to the right. The trains



STATION AT ORANIENSTRASSE.



OBERBAÜMBRUCKE AND STATION AT STRAULAUER THOR.

THE BERLIN UNDERGROUND AND ELEVATED RAILWAY.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

of three cars will seat about 125 people and have standing room for about 50 more. The stations are about 2,000 feet apart and the normal speed is from 18 to 25 miles per hour, allowing the trains to operate at intervals of five minutes or less than three minutes.

Each car weighs loaded about 25 tons and measures nearly 40 feet long, 8 feet wide and somewhat more than 10 feet high. The motor cars have wheels 33 inches in diameter, and the total length of wheel base of the trucks of these cars is about 6 feet. The motor cars weigh without passengers less than 20 tons, and the smaller ordinary cars weigh less than 15 tons. The brakes may be operated by hand as well as by compressed air, a motor-driven air pump being placed under each car. It is also possible to short-circuit the motors through resistances for obtaining an electric braking effect in case of an emergency.

In order to make the schedule trips, there are required 41 motor cars and 21 second-class cars. The signal lamps of the motor cars are automatically turned on when the trains enter the tunnel in the daytime. The cars are heated by electric heaters placed under the seats, and for illuminating the cars there are two circuits of six incandescent lamps.

The motors are of 70 horse power capacity, and are connected in series in starting and in parallel when the proper speed has been attained. The station stops take from 20 to 25 seconds. On account of the advantages of the electrical system in starting and stopping trains, the crowds can be handled to better advantage than those operated by steam locomotives.

(To be concluded.)

A VIEW OF THE BERLIN SUBWAY.

THE BERLIN UNDERGROUND AND ELEVATED RAILWAY.

NEW PROCESS FOR ORE CONCENTRATION.

A NEW process for concentrating ores by the use of oil is being introduced here by a company known as the Canadian Ore Concentration, Limited, London, England. Ernest E. Sawyer, chairman of the directors, recently visited the mines in this district and thoroughly explained the operation of the process to the owners. The increased percentage of recovery of values and the higher grade of concentrates produced by the "oil process," when compared with the results obtained by water-concentration methods, clearly demonstrated the superiority of the former.

The ores of the mines in this vicinity contain copper, gold, and silver; lead, silver, and gold; gold, copper, silver, and lead; and many other combinations. All the trials were successful. Ore from an important property on the British Columbia coast, containing 2.2 per cent of copper, showed by water concentration a loss ranging from 30 to 58.6 per cent, mainly arising from float mineral, the surface of the water being covered with a scum of metallic mineral which would not sink. By the "oil process," the loss was only from 1 to 7 per cent. The extraction was therefore 99 to 93 per cent of the assay value.

The process, called the "Elmore" process, is described as follows:

The ore having been reduced to a freely flowing pulp (oil and suitably pulverized ore), passes directly from the mill into the open end of a horizontal rotating drum, inside of which is fixed a helix with cross blades or buckets which lift up the pulp to a certain height and drop it again, at the same time propelling it forward to the opposite end of the drum, thus keeping the pulp in constant agitation for the few seconds which are occupied in its passage. With the pulp is also admitted a small quantity of thick, sticky oil, known as "summer drak oil." This is of course subjected to the same agitation as the pulp. It exercises the remarkable property of picking up and holding the mineral that is floating about or suspended in the pulp in minute particles. It does not appear to have any effect whatever upon the particles of rock with which it comes in contact.

The oil and pulp automatically discharge from the other end of the drum into a pointed box, or spitzkasten, in which the tailings or rock at once settle down and pass off with the water at the bottom, while the oil floats up to the top and carries with it practically all the values which the ore contained. From the top of the pointed box, the oil, with its mineral, flows off into a specially constructed centrifugal machine, where the oil is extracted from the mineral and is at once ready for reuse.

For close extraction, three mixing cylinders are sometimes used, the pulp passing from one to the other and receiving fresh streams of oil. A second centrifugal machine is also found desirable below the first, to further extract the oil and water from the concentrates. The concentrates are left in the machine practically free from oil.

The process was first tried in the laboratory, then on a small working scale, and then with a plant erected at Gladsir Mine, Wales, capable of treating about 50 tons of ore per week. After a lengthened trial of this plant, it was replaced by a much larger one, which treats 250 tons per week. The tests gave a recovery by oil of 90 per cent, as against 40 per cent by water obtained by the newest style of Frue vanners.

As an instance of the commercial utility of the process, the results obtained from ore from one of the best-known mining properties in Canada (Le Roi) may be cited. The treatment of the dump ore, containing one-half of 1 per cent of copper, showed that about 15 tons could at a small cost be concentrated into 1 ton containing 6 per cent of copper, together with a high recovery of gold and silver.

A report issued last December gave the cost of smelting Le Roi ore as $6 per ton (I believe it is about $4.50 per ton at this date) and as, by the use of this process, only 1 ton out of 15 tons would have to be smelted, the saving is self-evident.

The more finely the metallic mineral is disseminated in an ore (especially when consisting of tender sulphurets), the greater is the percentage of loss by water concentration. These losses, which it has not been found possible hitherto to avoid, are greatly reduced by this process, the finest and lightest float sulphuret, containing gold, silver, or copper, being readily taken up and retained by the oil.

It is said that plants have been ordered for mines in England, Wales, Sweden, and Norway.

The process appears to be specially applicable to low-grade sulphide ores, especially such as have a tendency to slime when crushed, and for treating tailings from richer ores. Experiments seem also to have demonstrated the feasibility of separating, at a small cost, sulphides, such as copper pyrites, from oxides, such as magnetite, etc.

Much of this valuable information has been given me by Mr. G. H. Master, one of the agents for the Spitzee Mines, Rossland, British Columbia.

For further information, parties interested should write to M. T. Wigham, 826 Salisbury House, London Wall, E. C. The process is patented in the United States and Canada.

G. A. OHREN, Consular Agent.

Rossland, September 12, 1902.

RUSSIAN AND AMERICAN PETROLEUM.

THE present condition of the coal supply of the United States and the possibilities of the large substitution of petroleum for coal as a fuel give an increased interest to the statistics of Russian petroleum as reported in Mineral Resources of the United States, 1901, soon to be published by the United States Geological Survey.

Since the year 1897, Russia has produced more petroleum than the United States. Beginning with 1897, the Russian production has been increasing by an average of over 12 per cent each year to the close of 1901. In round numbers the figures of production for the two countries are as follows: 1897—Russia, 54,000,000 barrels, United States, 60,000,000 barrels; 1898—Russia, 62,000,000 barrels, United States, 55,000,000 barrels; 1899—Russia, 66,000,000 barrels, United States, 57,000,000 barrels; 1900—Russia, 76,000,000 barrels, United States, 64,000,000 barrels; 1901—Russia, 85,000,000 barrels, United States, 69,000,000 barrels. The average annual increase during the five years for Russia has been 12.57 per cent; for the United States, 2.89 per cent—there having been a small decrease in the production of the United States in 1897, and a large decrease in 1898.

The facilities for handling the large Russian production are at present crude, costly, and wasteful. The markets are far away from the production. The main foreign shipping port at Batum, on the Black Sea, is separated by mountain chains from the chief center of production, Baku, on the Caspian Sea. To bring the oil to the seaboard, 400 miles of railroad must be traveled to the terminus of the pipe line, and then 160 miles still remain before reaching Batum. The capacity of the pipe line is almost double the capacity of the railroad so that the amount taken to Batum depends upon the capacity of the railroad. The Volga River is an outlet for 80 per cent of the production, and reaches many miles into the heart of the Russian Empire. But the Volga is frozen up for several months in the year and is subject to months of low-water stages in the summer and fall.

The price of 10 kopecks per pood, equal to 46 cents per barrel, for residuals or fuel oil, allowing 3.5 barrels to equal 1 ton of Russian coal, places a value upon the oil corresponding to $1.61 per ton for coal. When the oil is valued at 11 kopecks per pood, or 51 cents per barrel, the price is equivalent to $1.78 per ton for coal. This is a very fair price for the petroleum and should carry it a long distance before the cost equals the corresponding cost of the Russian coal, which is high-priced and inferior in quality. It is the irregular supply and the fluctuating price which interfere with the sale of larger quantities of fuel oil in the great interior of Russia. At the price of 10 kopecks per pood, or 46 cents per barrel, which is considerably higher than the average price for 1901, the oil cannot fail to secure a market, if transportation could be guaranteed, and at prices much in advance of the price named for comparison.

During the year 1900, Russia produced only about 17,800,000 short tons of coal, the higher grades of which sell for 14 to 16 rubles per ton, or about $7 to $8 per ton. During the same year the United States produced in round numbers 270,000,000 short tons of coal. All of the countries bordering on the Mediterranean Sea are poorly supplied with fuel. When it is considered that two-thirds of the total production at Baku (about 81,000,000 barrels in 1901) now finds a market as fuel oil, we have in the petroleum an equivalent of nearly 16,000,000 tons of coal.

When certain means of oil transportation now in contemplation in Russia are finished, the value of this liquid fuel will begin to be appreciated, and the internal industry of that great country will receive the benefits to which it is entitled from nature's bounty.

The total exports of petroleum, crude and refined, from Russia to foreign ports in 1901 were 428,657,210 gallons, or 40.33 per cent of the total exports of petroleum from the United States in 1901, which amounted to 1,062,750,306 gallons, valued at nearly $71,500,000.

The very great difference between the petroleum of the United States and that of Russia is shown in the statistics of refined petroleum. Of the total world's production of crude petroleum in 1901, 165,385,733 barrels, the United States produced 69,389,194 barrels, or 41.97 per cent, and Russia produced 85,168,556 barrels, or 51.49 per cent; and yet of the total production of refined petroleum of all grades in 1901, estimated at 1,500,000,000 gallons for all countries, the United States produced 911,120,944 gallons, or 60.7 per cent, and Russia 414,122,990 gallons, or only 27.7 per cent.

THE BLOCK SYSTEM.

Upon a great many railroad lines, and especially upon those on which the trains are frequent and rapid, an endeavor has for a long time been made to prevent collisions by means of signals placed along the track and collectively constituting what is called the "block system." The principle is exceedingly simple. Along the track to be protected are placed successive posts *A*, *B*, *C*, *D*. The train leaving a point *A*, is protected there by a signal set in the danger position. The same train, on reaching *B*, will find the signal there not set if the block, *B C*, is clear. As soon as the point, *B*, has been passed, a clear track can be had at *A*, and the signal at *B* will be set in the danger position for protecting the block, *B C*. The operation will be the same for all the successive blocks, the number of which is determined by the space to be left between the trains, that is to say, by their number and speed.

The system requires between the various signals a correspondence mechanism that has been realized in various ways which we shall now briefly recall.

At the outset, there was between two consecutive signal-towers merely a very simple exchange of the signals "track clear" or "track occupied," as the case might be. One of the apparatus used for this purpose was the Tyer (Fig. 3, No. 1). This apparatus, such as we represent it, is double, and sends signals over one or the other track, according to circumstances. The operator, upon pressing a push-button, exchanges with his colleague in the preceding or succeeding tower a signal indicating to each that the track is clear or occupied in the section in which he is interested. As may be seen, this apparatus and all those analogous to it establishes no interdependence between the signal and the correspondence apparatus. The train therefore is at the mercy of errors due to the negligence or inattention of the operators.

In order to remedy this grave inconvenience, there have been devised in recent years certain arrangements that prevent the setting of the "clear-track" signal by error. For this purpose, as may be seen in No. 2 of Fig. 3, the apparatus is somewhat analogous to the preceding; but here the levers that actuate the signals are operatively connected with a horizontal rod which is locked as long as the operator of the following tower has not signaled "track clear." This apparatus, which constitutes the locking block system, offers a greater degree of security than the preceding. The difficulty is to effect the locking at a distance. When the towers are very near each other, as they are upon the well patronized suburban lines, it is possible to have a mechanical connection between two of them. If such is not the case, an electric connection may very conveniently be employed. In this instance the tower man, by setting his semaphore, shuts off the current from an electro-magnet operatively connected with the locking bar of the preceding tower, thus unlocking the lever and allowing the operator there to lower the semaphore and show that the track is clear.

Many electric apparatus have been devised for this purpose. We shall be content at present to mention the principal one of them—the Lartigue semaphore in use upon several French railroad systems.

In order to have a still greater guarantee of safety, we may endeavor to cause the train itself to establish the signals. For some years past, various railroad companies have, in fact, adopted automatic apparatus that permit the train to "cover itself." Each "home" or danger semaphoric arm signal is preceded by a "distant" or warning signal that does not order a full stop, but only a reduction of speed. When the first axle attacks the striker of the "home" automatic danger signal, it causes the "distant" warning signal to be set behind the train. The most widely used signal of this type is the Aubine, which is employed upon several French railroads.

Another arrangement is that by which the train announces its approach by means of a pedal contact operated by the wheel. In No. 3 of Fig. 3, we represent such a contact placed in the interior of the track, which, when struck, cuts out a current and causes a grade crossing alarm, placed in front of the train, to sound.

In some cases, especially upon mountain lines that are often menaced by snow, an analogous mechanism registers, like a Morse telegraph, in the neighboring station, the passage of the axles of a train. It may be asked why such a solution is not made general and why the block system is not made completely automatic. The train in running upon the track would, by the use of a proper arrangement, announce its arrival and set signals in front and behind. The advantage of the system is that it makes errors impossible and effects a saving in the expense of tower operators. Such an advantage is largely counterbalanced by the possibility of a derangement that would stop trains without any reason. Automatic signals, moreover, would involve expenses of construction and maintenance greater than would signals of the ordinary kind. Nevertheless, the use of them is rapidly extending in the United States, where several railroad engineers have pointed out that their operation is satisfactory and accompanied with economic advantages.

The agent of transmission used between the various signals is electricity. The automatic block system with electric transmission presents two distinct varieties which we shall examine in succession: (1) Circulation of the current in the rails of the track.—The track is divided into sections, one of which, *A A*, we represent in Fig. 1, insulated from the neighboring ones. The rails of the same track in the next section are connected electrically at *B*. A battery, *P*, placed at one extremity of the section, sends the current that traverses the electro-magnet, *R*, the armature of which is therefore normally attracted. If a train, represented by one of its axles, *T*, is running in the section under consideration, it will establish a short circuit and the armature of the electro-magnet will fall. This movement of the armature is utilized for establishing and breaking circuits by means of what are called "front contacts," *F*, and for making others, *G*, called "rear contacts."

Near the magnet, *R*, and the corresponding semaphore (Fig. 2), is arranged a battery, *P'*, which actuates a motor that sets the semaphore, *S*. With such an arrangement, it will be seen that if a train is running upon the track in the section, *A A*, a short circuit will be established and the magnet, *R*, will become demagnetized; the front contact, *F F*, will break the circuit of the battery, *P'*, the motor that sets the "open track" signal will be no longer actuated, and the signal, through the influence of its counterweight, will assume the danger position. After the train has left the block, things will resume their prior position.

The above, however is a somewhat theoretical statement. As a matter of fact, the signals are generally actuated by means of a line circuit. The track circuit, operating as shown in Fig. 1, opens or closes the magnet circuits along the track, and the magnet armatures, in turn, through contacts *F* and *G*, open or close special circuits in which are interposed line relays that control the station signals. It may be seen from what has been said, that the principle of the system resides in the use of track circuits of which the relays open or close other circuits called "line circuits."

An installation of this kind was shown at the Exposition of 1900 by the P. L. M. Company. It was a variant of the Hall system, which is widely employed in the United States.

(2) Circulation of the current through some other medium than the rails.—This is the system adopted by the Metropolitan Railway of Paris. For this line, the use of the automatic block system was indicated by reason of the very great frequency of the trains and the regularity of the service. Upon each track of a station there is an incoming and outgoing signal. These signals consist essentially of a box with two windows, one of which gives a red and the other a white light. A shutter controlled by an electro-magnet closes each window in succession.

The control of the signals is effected here by rail contacts and an electric circuit independent of the rails.

A train coming before a white, that is to say, a clear-track signal, passes it and its wheels immediately throw a contact that interrupts the current and sets the red light signal. As the train passes the following signal, it changes it to red and at the same time turns the first one to white again. The train is therefore covered at every instant by two protecting signals.

A complete description of the electric conductors controlling the signals would lead us into details incompatible with the scope of this article. It will suffice to state that the principle is the same as in the preceding case. The train, in passing over a contact, interrupts a circuit and demagnetizes a magnet. Contacts in front and behind open and close other circuits, which establish a relation between the various signals.

It seems that in the United States preference is given to the automatic signals with track circuit. The superintendent of the signal service, having electricians and lantern men under his orders, assures the proper operation of the signals and the efficient state of the electric conductors.—Translated for the Scientific American Supplement from La Nature.

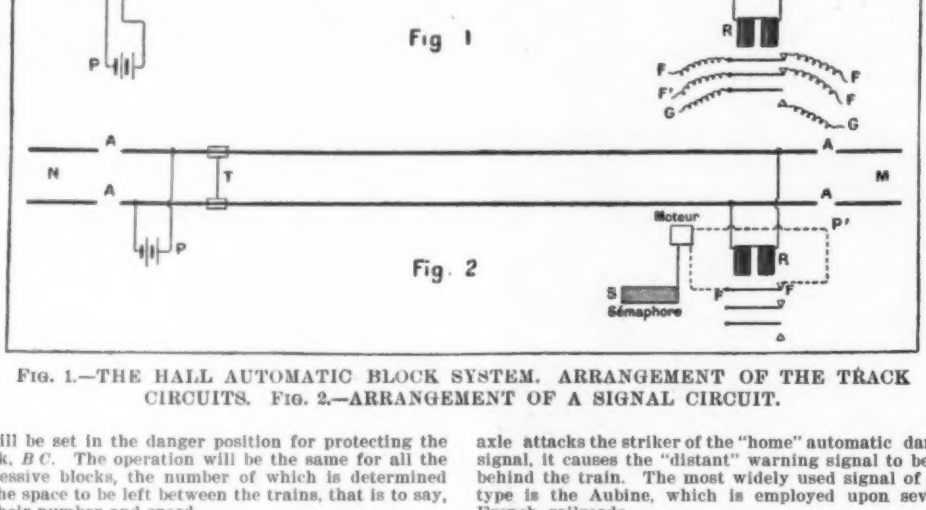


Fig. 1.—THE HALL AUTOMATIC BLOCK SYSTEM. ARRANGEMENT OF THE TRACK CIRCUITS. Fig. 2.—ARRANGEMENT OF A SIGNAL CIRCUIT.

Fig. 3.—1. TYER APPARATUS FOR DOUBLE TRACK. 2. LOCKING BLOCK SYSTEM APPARATUS. 3. PEDAL CONTACT FOR GRADE-CROSSING SIGNAL.

RECENT PROGRESS IN LARGE GAS ENGINES.*

The last few years have seen a development in large gas engines which has but few parallels in the history of engineering enterprise. Gas engines of 1,200 and 1,500 horse power are already working, and others of 2,000 to 4,000 horse power are being constructed. In the Paris Exhibition of 1900 the 600 horse power Cockerill gas engine created much surprise, but now the makers have in hand an engine of 2,500 horse power, and are quite prepared to build a 5,000 horse power gas engine.

In this country the first engines above 400 horse power were started in 1900 and ran with Mond gas, but at the present time the two leading English manufacturers have delivered or have under construction fifty-one gas engines of between 200 and 1,000 horse power. Of these Messrs. Crossley Brothers, of Manchester, supply twenty-eight engines, having an aggregate of 8,300 horse power, or an average of 296 horse power per engine, and the Premier Gas Engine Company, of Nottingham, supply twenty-three engines with a total of 9,300 horse power, giving an average of 404 horse power per engine. These two makers collectively supply 17,600 horse power, and of this power 12,500 horse power is for driving dynamos.

This is a striking proof of rapid progress, but we have to look abroad for the great achievements in this direction. Neglecting, throughout this paper, all engines below 200 horse power, we find that Messrs. Körting Brothers and their licensees have made or have under construction thirty-two gas engines with a total of 44,500 horse power, averaging 1,390 horse power per engine. The Société Anonyme John Cockerill, of Seraing, and their licensees come next with fifty-nine engines, having an aggregate of 32,950 horse power; so that the average size of the engines built by this firm is 558 horse power. The Gasmotoren Fabrik Deutz take the third place with fifty-one engines developing collectively 20,655 horse power; and are followed by the Deutsche Kraftgas Gesellschaft and licensees, working under the Oechelhauser patents, with engines numbering twenty-eight and giving 16,900 horse power.

Although America has lagged somewhat behind the Continent in adopting large gas engines, there is evidence that this state of affairs will not long remain. The Snow Steam Pump Works, of Buffalo, N. Y., have only recently started the manufacture of gas engines, yet they have already put to successful work six gas engines of 1,000 horse power each, and are now constructing two enormous gas engine gas compressors of

* Abstract of a paper read before Section G of the British Association at Belfast by Herbert A. Humphrey, M. I. Mech. E.

4,000 horse power each, the first to be running next November, and the second by January, 1903. The Westinghouse Machine and Manufacturing Company, of Pittsburg, have made gas engines of 1,500 horse power, and are prepared to build sizes up to 3,000 horse power, either horizontal or vertical.—Journal of the Society of Arts.

A POWER MILK SEPARATOR.

A NEW form of separator was shown by the Crown Separator, A2, Southwark Bridge Road, S. E., at the recent Carlisle Show. The novelty lies in the bearing, for there is only one. In the center, at the base, there is a fixed "dead" spindle *A*, and over this is a sleeve *B* which runs on five sets of balls. It will be seen that the ball-races are set at about an angle of 45 degrees, so that they form both thrust and side bearings. The arrangement can be easily followed in the engraving. The lubricating arrangements are very complete. The oil drops in at the side, passes up the center spindle, overflows into a hollow spindle, is then thrown out by centrifugal force, and thoroughly covers all the rotating parts. Finally, it escapes, and can be collected. The disks *C* in the bowl are of a new form. This machine runs very easily, and from its construction stands lower than most separators, so that it is easy to get at.

The principal feature in the dairy this year is the extended use of pasterizers for the treatment of milk before separation. As constructed by the Dairy Supply Company, Limited, Museum Street, London, this apparatus consists of a vessel, through which the milk runs, surrounded by a steam jacket. As the steam comes into contact with the cold surface it, of course, condenses, and forms a layer of water which runs down the surface, and acts as a non-conductor of heat, so that it materially interferes with the efficiency of the pasteurizer. To overcome this a series of rings are fastened in the steam chamber, which divert the condensed water and cause it to drip to the bottom, bringing the hot steam into direct contact with the whole of the surface. To keep the milk in constant motion, so that it shall not suffer from local heating, horizontal rotating plates are used upon the stirrer in place of arms, which have hitherto been used. Experiments show that with the old style of apparatus there is a great inequality in the heat of the milk from the center to the circumference. The horizontal stirrers prevent the milk rising except by passing through a narrow opening in the heated surface, and thus insure all the milk being equally heated and remaining in the pasteurizer for the proper length of time. The stirrer is driven either by a belt or by a small engine. After raising milk to a temperature of about 180 degrees in pasteurizing, it has to be cooled. For this purpose the Dairy Supply Company use an interchanger. This receives the hot milk after it has left the pasteurizer and the cold milk on its way to the pasteurizer, the two flowing in opposite directions, the heat passing from the hot milk to the cold, and thus being economized.

Messrs. R. A. Lister & Co., Ltd., Dursley, show several steam pumps for elevating milk, the valves of the steam cylinders being actuated by steam admitted by ports controlled by the main piston.

RESEARCHES ON ARGON AND ITS COMBINATIONS.

By M. BERTHELET.

THAT chemical combinations of this element exist in nature cannot be doubted, in view of the existence of various ores which disengage the gas under the influence of acids. The absorption of argon by benzine and by carbon sulphide, submitted to the influence of the electric effluvium under the special conditions I have already described, engenders solid compounds, stable cold, of which the pyrogenous decomposition reproduces argon itself, as I have demonstrated by thorough experiments. It appeared to me advantageous to pursue the subject on more numerous samples and to endeavor to give a more definite character to the argonides, that is to say, the derivatives of hydrocarbonated compounds. These derivatives are obtained by the same processes that give rise to the electric combination of nitrogen with the most varied organic principles.

The experiments I will describe have been conducted on a new sample of argon which Lord Ramsay has kindly furnished me. This sample was contained in a well-closed glass bottle. It occupied 650 cubic centimeters of space at ordinary temperature and pressure, or 650 cubic centimeters reduced to the dry state at 0 deg. and 760 millimeters of pressure. Unfortunately it was not pure. It contained 30 per cent of nitrogen free from oxygen, as I have ascertained by three tests.

In the first two the nitrogen was absorbed, combining with oxygen in presence of concentrated potash, under the influence of a series of strong electric sparks. In the first instance the reaction continued for 15 hours, giving rise to an absorption of 30 hundredths of the initial mixture.

In the second case the operation lasted for 24 hours, with absorption of 30.6 hundredths.

The third test was effected by causing the effluvium to act on a gaseous mixture of argon and glycolic ether (ethylene pseudoxide), one of the best absorbents of nitrogen. The absorption was 29.5 hundredths.

Thus 455 cubic centimeters of pure argon were disposed of. The necessity of purifying the argon from its mixture with nitrogen has rendered the work troublesome, my apparatus not allowing of operating on more than 100 or 120 cubic centimeters of the mixture at my disposal, with the addition of the suitable proportion of oxygen (2 vol. per 1 vol. of nitrogen) or in all about 200 cubic centimeters. Each operation was executed in a large eprouvette over mercury, arranged as I have often described. It lasted from 15 to 24 hours with a continuous sparking current furnished by an inductive coil, fed by six storage cells, and regulated by a vibrating interrupter, which emitted several hundreds of sparks per second.

By reason of these obstacles, I have not pushed my investigation as far as I had at first projected. However, the facts I have observed add a number of points to the knowledge previously existing on the properties of argon and on the action of the effluvium.

My inquiries have not been affected by any preconceived theoretic opinion. They may be thus enumerated: Experiments relating to the action of argon on different organic compounds, under the influence of the electric effluvium; special experiments on benzine; experiments on compound mercurial radicals; special experiments on carbon sulphide.

I have also experimented with electricity, acting by its tension alone, in a continuous way, that is, by the potential of 200 Leclanché elements, developing a tension of about 200 volts, maintained without interruption for three months.

I operated on a volume of argon between 5 cubic centimeters and 10 cubic centimeters. It is not advantageous to exceed these volumes in effluvium tubes, on account of the slight capacity of the annular space in which the action takes place.

The gases are measured at first over mercury in graduated tubes at a temperature and pressure exactly known, the gases being perfectly dry. Then they are transferred to the tube designed for the effluvium experiments; it is connected with a large coil of platinum or aluminium. The interior concentric tube is introduced into this—a tube terminated outside in the form of a reversed siphon, which is filled with sulphuric acid. The whole is brought from the large mercury vat over a small porcelain vat filled with mercury and immersed in the large vat, in order to arrange in it the system of concentric tubes.

The platinum or aluminium coil is then put in connection with one of the poles of the induction coil, the other pole communicating with the sulphuric acid.

The rapidity of the effects depends on the diameter of the annular space, on the surface of the effluvium tubes, and on the electric tension. Strong tensions are to be avoided, as well as copious showers of fire, with the corresponding heat, which destroy compounds not very stable.

The Ruhmkorff coil employed for developing the effluvium is 40 millimeters in length, with an exterior Leyden jar. It is fed by three or six storage cells (6.3 to 12.6 volts). The distance of the sparks furnished by the coil and the condition of its employment (several hundreds of sparks per second) is regulated at 6 to 8 millimeters.

It is clear that the coil can furnish much stronger sparks, but at a reduction of the number of interruptions to ten or fifteen per second, which in these experiments would be less favorable.

The technique of this class of experiments is delicate and requires to be studied in advance as to nitrogen, the reactions varying with the electric tensions, the temperature developed and various other circumstances.

I. EXPERIMENTS RELATING TO THE ACTION OF ARGON ON VARIOUS ORGANIC COMPOUNDS.

My experience leads me to divide the hydrocarbonated compounds on which I have operated into three groups: the fatty or saturated series, the benzenic series, various cyclic series. The mercurial radicals were studied by themselves.

I will commence with the fatty series, of which the negative results bring into greater prominence the positive results of the benzenic series.

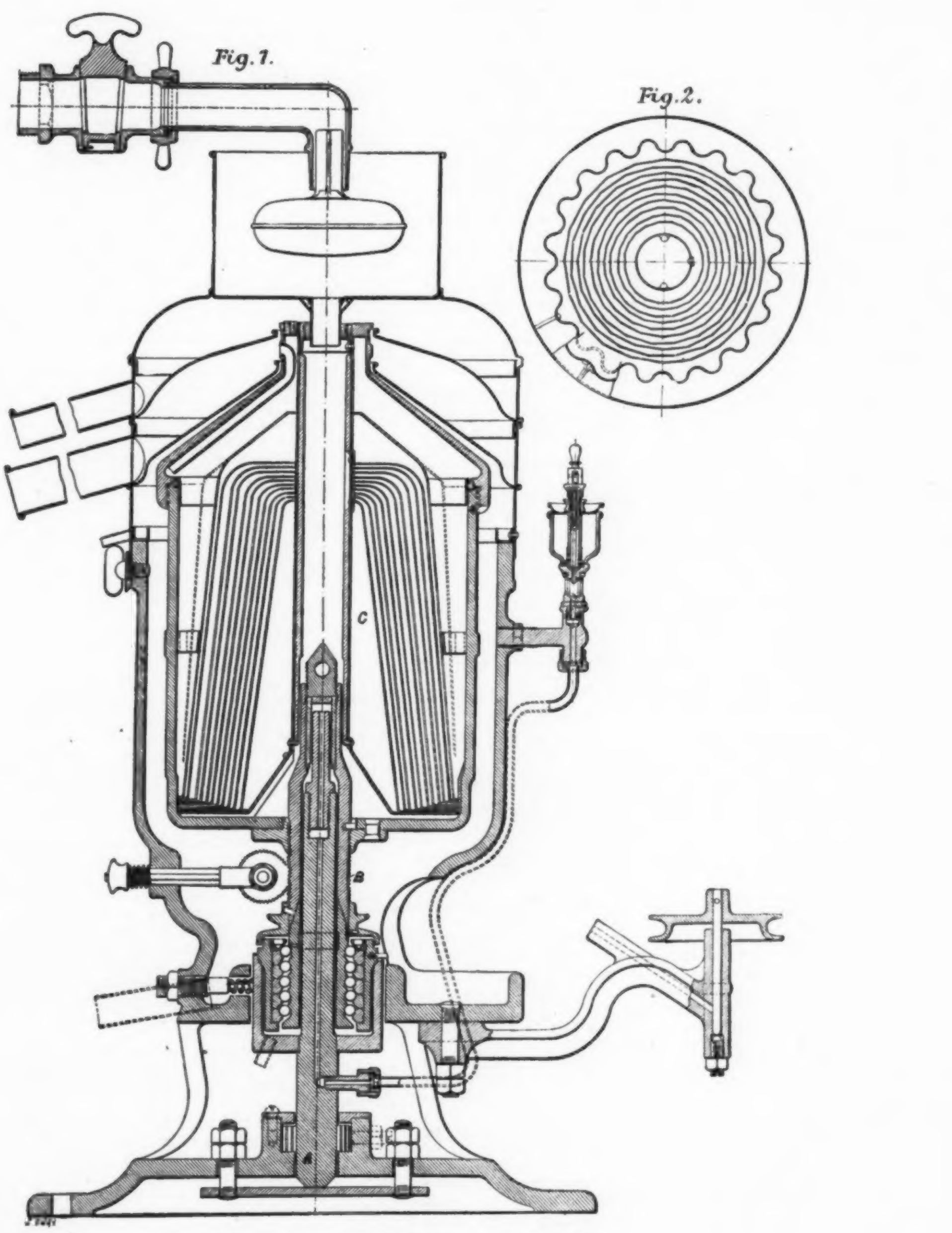
In this case, as in the others, immediately after the termination of the reaction of the effluvium, the apparatus is brought over the large mercury vat and the small vat removed. The tube, of siphon form, is first removed, detaching gently the bubbles of gas which may adhere to it. In case of need, this tube may be allowed to lie in a larger eprouvette over the mercury, without leaving it for a moment in contact with the air; this allows of verifying very exactly the absence of adhering bubbles.

When the siphon tube is removed, the gas remaining within the enveloping tube may be poured out into a large eprouvette over the mercury with suitable precaution, in order not to leave any trace in the tube. From this it may be poured the second time into a graduated tube, and the remaining gas measured exactly.

As this gas at times contains hydrogen, carbon oxide and other combustible fluids, it is indispensable to complete the analysis by combustion. For this purpose a known quantity of oxygen is added, and it is decanted into a eudiometer. If it does not burn, a small quantity of a detonating mixture, measured accurately, is added to it, and saturation produced in the eudiometer. Then the remaining mixture is brought again into a graduated tube, measured, dried and the carbonic acid and the excess of oxygen absorbed, measuring them by differences with suitable precaution. Finally, the residue is measured, consisting of non-combined argon, a residue equal to the initial volume in the case of the fatty series, but less in the case of the benzenic series.

A. FATTY SERIES.

1. Ethylene and argon in equal volume, twenty-four hours. The mixture diminished in volume, but remained greater than that of the argon. The eudiometric analysis showed that the product was hydrogen mixed with a small quantity of formene, or of equivalent



"CROWN" POWER MILK SEPARATOR.

ethane. With ethylene, there was no absorption of argon.

In the course of this experiment, performed under atmospheric pressure, no luminescence was visible in the day time. At night, a yellowish light first appeared, becoming bluish, in which the spectroscope could distinguish no distinct lines.

2. Glycolic ether and argon, twenty-four hours. The product consisted of hydrogen and formene. Glycolic ether or pseudoxide of ethylene is gaseous at the temperature of 20 degs. It is one of the best absorbents of nitrogen. There was no absorption of argon, and no luminescence in the day time.

The results were the same with *gaseous aldehyde, acetone, amylene, petroleum ether, propionitride and sulphocyanide of allyle.*

In the case of amilamine, there was a disengagement of nitrogen. The volume of the nitrogen was obtained by absorption with oxygen in presence of potash, and with the aid of a long series of electric sparks. In this case, as in the preceding, there was no absorption of argon, and no luminescence in the day time.

B. BENZENIC SERIES.

The course of the experiments and of the analyses was precisely the same. Contrary to what occurred in the fatty series, all produced a greater or less absorption of argon, the coil being fed with tensions from 6 to 12 volts.

The contrast was not less striking in the luminescence and in the spectral analysis. After some hours, that is, in consequence of a slow and progressive reaction between the argon and the argonic vapor, a continuous green luminiscence, more or less intense, appeared in the day time. This luminescence was developed in the gases under atmospheric pressure, and without recourse to stronger tensions than those that have been mentioned. In nearly all cases it was visible in full day light.

The spectroscope distinguished the lines of argon, of mercury, of carbon and of hydrogen.

1. Benzine. It is necessary to eliminate at the close by eudiometric combustion the excess of benzine vapor. Varying the conditions of duration, of tension, of relative mass, etc., in the different experiments the volume of argon absorbed amounted to 8, to 7, to 5, and to 3 hundredths of the initial volume of this gas respectively.

2. Toluene. Very distinct green luminescence in the day time, like that of benzine, with the same spectrum, although feebler, especially at the outset. The absorption of argon was after a few hours from 2 to 3 hundredths.

3. Cymol. Quite feeble diurnal luminescence. Absorption of argon, 6 hundredths.

4. Turpentine. The luminescence was first whitish, then greenish at twilight, the time when the daylight declines sufficiently to render the luminescence more manifest. Spectrum, similar. The volume of hydrogen disengaged was slight. The absorption of argon was 2 hundredths.

5. Mettylphenic Ether. The diurnal green luminescence appeared at the end of an hour. It was quite beautiful, though feebler than that of the benzine. The spectrum was the same; the absorption of argon was 5 hundredths at the end of twenty-four hours.

6. Phenol. Very slight green luminosity, visible at twilight. The absorption of argon was 2 to 3 hundredths.

7. Benzoic Aldehyde. The same observation; absorption of argon, 1 to 2 hundredths.

8. Aniline. Green luminescence, feebler than with benzine; absorption of argon, 1 hundredth.

9. Phenyl Sulphocyanide. Slight luminescence, but plainly visible. Absorption of argon, 2 hundredths.

10. Benzonitride. Beautiful green luminescence, appearing rapidly. Spectrum well defined. Absorption of argon, 5.3 hundredths.

It appears that benzine and its derivatives develop with argon the characteristic diurnal luminescence, the intensity increasing with the increase of the vapor tension; the phenomenon being slight with phenol, benzoic aldehyde, and phenyl sulphocyanide; more marked with cymol and aniline, and especially striking with benzine, toluene, benzonitride and anisol. This luminescence corresponds with the absorption of argon, and is especially distinct with the more volatile bodies.

The contrast of these results with those furnished by the fatty series shows that there is a special compound peculiar to the benzenic series, that is, a phenyl-mercur-argon of feeble tension and limited in formation, both by the vapor tension peculiar to the phenylic compound which furnishes it, and by the complex conditions of its stability and dissociation.

It may be remarked that the compounds of the fatty series and those of the benzenic series have been compared in two parallel groups, responding to the same functions.

C. VARIOUS CYCLIC COMPOUNDS.

1. Furfurol. Absorption of argon uncertain; luminescence visible at twilight, with a special spectrum perceptible with the spectroscope.

2. Thiophene. Absorption of argon, 3 and 2.5 hundredths (two experiments). Greenish luminescence, visible at night; with special spectrum.

3. Pyrrol. Absorption uncertain; luminescence slight.

4. Pyridine. Absorption of argon, 2 hundredths (two experiments). Marked luminescence at twilight, with special spectrum.

II. EXPERIMENTS RELATING TO THE ACTION OF ARGON ON BENZINE.

1. Argon and liquid benzine of a volume equal to one tenth of the volume of gaseous argon, that is, in excess. The specific luminescence appeared at the end of two hours, the liquid benzine continuing to a certain extent, though in great part destroyed. After destruction of the vapor by detonation, the absorption of the argon was found to be 3 hundredths.

2. A few drops of benzine were added to the argon not absorbed, and the reaction of the effluvium was prolonged for thirty-six hours. The luminescence ascertained with new absorption, 4 hundredths. On continuing for seventeen hours without any addition of benzine, the absorption increased only 1 hundredth, or, in all, 9 hundredths. It is seen that the absorption became manifest at the same time with the luminescence, and that it stopped at about a certain limit, which seemed to depend particularly on the relation between the argon and the tension of the vapor of mercury, and of the phenyl-mercur-argon; that is, on the tension of dissociation of the last named compound.

3. In another experiment the luminescence being already distinct for an absorption of 5 hundredths of argon, the limit was reached at about 7 hundredths; in still another, at about 8 hundredths. These limits appear to be connected with the electric tension of the effluvium in the annular space. The temperature developed in this space certainly exerts an influence. When it is too high the compound is destroyed, or, what amounts to the same thing, is not formed.

4. When all the benzine was destroyed, if the electric action was prolonged indefinitely, the luminescence at the end of a long time diminished and finally disappeared.

5. On operating with equal volumes of gaseous argon and of liquid benzine, that is, with a large excess of benzine, the luminescence had not appeared at the end of twenty-two hours, perhaps because the excess of liquid had retained the phenyl-mercur-argon in solution. The apparent absorption of argon rose, however, to 14 hundredths, the greater part of the benzine being polymerized. The absorption was in reality the sum of the two effects, the chemical absorption and the simple solution.

6. The green luminescence of the phenyl-mercur-argon, ceases at the moment when the electric current is stopped. If the operation is performed at twilight, the eye is certain to perceive for a moment a violet glimmer, which in its turn is effaced, leaving only the permanent yellow tint of the polymerized derivative of the benzine adherent to the walls of the effluvium tube. If the current is re-established, the green tint immediately reappears.

7. I had preserved over a mercury vat for three years, a sample of argon, regenerated at that time by the decomposition of the compound which it had first formed with carbon sulphide, then put in presence of benzine and submitted to the action of the effluvium up to the formation of luminescent phenyl-mercur-argon. The benzine had entirely disappeared at the time of the latter experiment.

No change having been made in the arrangement of the apparatus or of the materials, whether gaseous or converted, it seemed to me of interest to endeavor to reproduce the specific luminescence. Eleven hours were necessary for the effluvium to cause it to reappear, with its emerald light and distinctive lines. The electric action was suspended for eight hours, then recommenced; ten minutes were this time sufficient.

This experiment demonstrates that the phenyl-mercur-argon, reabsorbed by the benzenic polymer, and perhaps at length decomposed spontaneously, like ozone and oxygenated water, reappears when its constituent elements are submitted to the prolonged action of the effluvium.

III. EXPERIMENTS RELATING TO THE ACTION OF ARGON ON CARBON SULPHIDE.

1. Argon and Liquid Carbon Sulphide. Tension of current, 6.3 volts. Time, twenty hours at 22 deg. The absorption was 7 hundredths. The compound formed is soluble, of fawn color, without coaly mixture. By operating on this compound, as in my first experiment, a small quantity of argon was regenerated by the action of the heat, reproducing the green luminescence with benzine; that is, the characteristic phenyl-mercur-argon.

2. Another experiment operated under the same conditions at the end of six hours yielded 6 hundredths of argon. To effect the analyses of the gases, the method I have already indicated was followed, consisting in absorbing the vapor of carbon sulphide with a fragment of potash previously soaked in alcohol, and absorbing the alcohol vapor with concentrated sulphuric acid.

3. Argon and Carbon Sulphide. Similar experiment, the tension of the current being 12.6 volts. Time, 24 hours. A rain of fire was produced. The compound formed was blackish and coaly. There was no absorption.

4. This experiment, under strong tension, was repeated with a larger proportion of carbon sulphide. This also produced a coaly matter, with no absorption of argon.

5. The argon not absorbed in the last experiment received a new addition of carbon sulphide and was subjected to the action of the effluvium for several hours, the tension of the current being only 6.3 volts. The compound formed was yellow, not coaly. The absorption of argon took place as in the first experiment; the amount was 5 hundredths.

These observations revealed a circumstance which I had not noticed in my old experiments, namely, the necessity of not operating with very high tensions and heating, especially with carbon sulphide.

6. Argon 100 volumes; H_2 = 175 volumes; CS_2 liquid. In twenty-four hours all the hydrogen had disappeared. The absorption of argon amounted to 10 hundredths.

7. Argon with 0.1 cubic centimeter of mixture of liquid carbon sulphide and benzine of equal volume. The absorption of argon was 9 hundredths. The product, decomposed by heat at the dull red, regenerates various gases, as the benzenic derivative does.

I have sought to define more precisely the relation which exists between the fixed argon and the converted carbon sulphide. I have thus found the following relations between the volumes of the gas absorbed and of the gaseous carbon sulphide combined under the prolonged influence of the effluvium: $2CS_2$ fixes H_2; $4CS_2$ fixes Az_2; $34CS_2$ fixes $(argon)_2$.

In all cases a solid compound is formed, amorphous, of fawn color, polymerized. But it cannot be affirmed that this compound is not formed by a mixture of a definite compound with a variable excess of polymerized sulphide.

In a word, two actions developed by the effluvium take place parallelly, namely, a combination of hydrogen or of nitrogen or of argon, and a polymerization, perhaps with separation of the sulphur of the carbon sulphide.

Nothing proves that the second phenomenon is negligible or even connected with the combination, any more than the formation of ozone is with the formation of nitrous vapor under the influence of the effluvium, at the expense of a mixture of nitrogen and oxygen, such as the atmospheric air. Without doubt, the last two reactions are simultaneous with strong electric tensions; but the ozone is formed only by weaker tensions. This observation, which I made formerly,* has been lately utilized in industry for producing ozone exempt from nitric compounds.—Annales de Chimie et de Physique.

REPORT OF BUREAU OF STEAM ENGINEERING ON LIQUID FUEL FOR NAVAL PURPOSES.

The use of crude oil as a combustible for marine purposes has probably increased to a greater extent during the past two years than during the previous century. This has been due to several causes. The character of the oil lately discovered throughout the world is particularly applicable for use as a fuel. The oil fields are likewise near tide water, and therefore it is possible to construct pipe lines to the sea and deliver the product on board the tank steamers at comparatively slight cost. There is also good reason for believing that the wells are not likely to be soon exhausted and that an ample supply can be assured for an increased demand of the future.

It is evident that there is a very stronge desire and purpose upon the part of many shipowners to substitute oil for coal. The thermal, mechanical, and commercial advantages that would result from a change are so well known that it is unnecessary to recount them. Nearly every reason that can be advanced for using oil as a fuel in the mercantile marine is also applicable to the Navy. In the case of warships, however, there are also military benefits to be secured that are as important as the commercial and mechanical advantages.

Any fuel installation that will obviate the smoke nuisance, reduce the complement in the fire room, extend the steaming radius of the war vessels, and permit maximum speed to be obtained at shorter notice, increases the efficiency and value of the fighting ship.

The numerous experiments that have been made by several naval powers during the past forty years in the attempt to use oil as a fuel show how important this question is regarded by military experts. It is now plain why success was not attained. There was too much effort exerted to burn oil in the same manner as coal. It is now realized that the oil should be atomized (it is impossible to completely gasify it) before ignition, and that the length of the furnace, the volume of the combustion chamber, and the calorimetric area are factors which must be considered. In fact it is highly probable that it may be found advisable to design a special boiler for burning oil.

As more time, talent, and money are now being devoted to the solution of the problem, the hope of securing success has been greatly strengthened. Many unreliable statements have been published as to the success secured, but careful investigation shows that they were inspired by interested parties. It can be well understood that it is exceedingly difficult to secure reliable data at the present time. The several shipowners, manufacturers, and inventors are not inclined to tell of their disappointments, reverses, or failures. Those who have attained success as a result of experiment and experience do not feel called upon to give the world information that has been obtained at considerable cost and trouble.

Expert testimony is often of doubtful value. With regard to such testimony, a distinguished jurist once remarked that its character frequently depended upon who paid the retaining and professional fee. In view, therefore, of the trifling amount of reliable data extant, the Bureau has projected an extended series of tests to determine the value of liquid fuel for naval purposes. These experiments commenced a few months ago. Taking into consideration the inevitable delay that must result from the installation of various burners, and recognizing the fact that competitors expect and should be permitted to make preliminary trials, it can be stated that the experiments have been conducted with considerable rapidity. It takes about one week to install a new burner, make preliminary tests, and conduct two official trials.

In some quarters there seems to be a prevailing idea that the Government has established an experimental plant where inventors can have the opportunity of developing and perfecting their appliances. The Bureau has no such purpose, for it is expected that each competitor will carefully study the detailed drawings furnished him of the experimental plant, and therefore be prepared to fit his appliance and be ready for a preliminary trial in two days from the time the plant is placed at his disposal.

The problem of using liquid fuel for naval purposes is quite distinct from the problem of its use in the mercantile marine, although the conditions on passenger and freight ships approximate very closely in some respects to service requirements. For ships of war the problem can therefore be solved only by the Department making its own tests and experiments. The performances, however, of the merchant ships having oil-fuel installations have been carefully observed. Representatives of the Bureau have been officially directed to report and observe upon the efficiency and sufficiency of such installations. Some of the most successful marine installations on both the Atlantic and Pacific coasts have been examined. The owners of the steamers "J. M. Guffey," "Paraguay," "City of Everett," and "Mariposa," having permitted the Bureau to report upon the oil-fuel installations of those vessels, a careful and extended investigation as to the character of each of their plants has been made. The liquid-fuel board has also examined the method of refining oil, and the Department has communicated with scores of individuals and corporations who have demonstrated by actual experience that their appliances possess merit.

The more this question is investigated the more in-

* Essai de Mecanique Chimique, II. p. 375.

tricate seems the problem of successfully installing an oil-fuel appliance on board a battleship. It ought to be successfully used on the torpedo boats, as well as upon auxiliary naval vessels that steam between regular ports. For the army transport service it might prove very desirable, since a supply of oil could be maintained at the several calling ports. In regard to the installation on the large powered battleships and armored cruisers, there are three distinct features which must be considered, viz: The mechanical, commercial, and the structural. Regarded from two of these view points it seems as if it would be some time before "coaling ship" ceases to be an evolution upon the war vessel. While both the naval and mercantile vessels traverse the ocean, there is a wide difference in their construction as well as in the nature of the duty performed, and this must be taken into account in designing the motive plant.

In the investigation of the subject of using liquid fuel for naval purposes it will be necessary to give due weight to the various features that will influence, if not determine, the solution of the problem. The question, therefore, comprises the following divisions:

First. The engineering or mechanical feature.

This relates to the efficient and economical burning of oil, and to the possibilities of increasing the consumption at short notice, so that maximum power can be readily and easily obtained. From the time the mechanical experts realized that the efficient, economical, and rapid burning of liquid fuel was greatly dependent upon the success secured in atomizing the oil there was rapid development. It was only a few years ago when the oil was simply thrown into the furnace by means of an injector. When that method was used the evaporation was dependent to a great extent upon the amount of incandescent surface that could be secured to ignite the fuel. It has only been within the last three years that the exceeding importance of atomizing the oil has been recognized.

It may therefore be affirmed that the efficiency of the burner is simply proportionate to its power to atomize the oil and then to turn these minute particles of oil into a mixture of combustible gas and fine particles of carbon, so that complete combustion, as well as ability to force the consumption of the oil, can be secured. There are many burners which can atomize the oil quite satisfactorily, and, as constant and progressive improvement is being made in this direction, the engineering and mechanical problem is nearing solution. The heating of the oil, as well as the heating of the air required for combustion, must be provided for, and extended experiments should be made to determine the simplest and the cheapest methods of attaining these objects.

The necessity for heating the air requisite for combustion should be impressed upon all contemplating the use of liquid fuel as a combustible. It would be best to force the passage of this air over heated surfaces either by forced or induced draft, but as this might involve considerable expenditure for installation, it is possible that simpler means might be effectual. The Bureau hopes before these experiments are concluded to make a special series of tests showing the evaporative efficiency secured when admitting the air to the furnace at different degrees of temperature.

The mechanical method of introducing the oil was so inefficient in the past that even experts were not able to burn the amount of oil desired. It has always been possible to burn some oil and to secure nearly the full thermal efficiency of the combustible. The great difficulty in the past was due to the fact that no one seemed to know how to burn enough oil and yet have it under control. There is therefore no record that, previous to two years ago, any boiler ever evaporated the amount of water with oil as a combustible that was secured under forced-draft conditions with coal as a fuel. Stated in another way, the boiler could not be forced with oil to the same extent as with coal. The experiments conducted by the liquid-fuel board have shown that it is now possible to force the combustion of oil, and that the greatest evaporation per square foot of heating surface secured with coal can be greatly exceeded by an oil-fuel installation of modern design where provision has been made for atomizing the combustible and heating the air and oil. Continued experiments should therefore be conducted under Government supervision.

The liquid-fuel board has already secured valuable information upon most of these points. A great service will be rendered the engineering interests of the country if further experiments can be conducted under the auspices of disinterested officials of the Navy, who, by reason of their training and experience, should be particularly qualified to carry on such tests. The engineering or mechanical features of the problem will undoubtedly be solved in a degree materially satisfactory to maritime and manufacturing interests, if not to naval experts, by further experimental work of the character that has been performed.

Second. The commercial feature.

This relates to the question of cost and supply. It may be regarded as a certainty that, except wherein unusual conditions prevail, the cost of oil for marine purposes will generally be greater than that of coal. The cost may be less for vessels departing from the Gulf and California sea ports, but the rule will hold elsewhere. While the question of cost should be of secondary importance in military matters, it must be taken into consideration. It is the expense of transportation that will always prevent the oil from being a cheap combustible. While it may be put on the tank steamer very cheaply at ports like Point Sabine, its commercial value will be determined by the cost of delivery at commercial and maritime centers. This feature of the problem is beyond the ability of the Navy to control, but it must be regarded as an important phase of the subject.

In considering the matter of cost the fact should be remembered however that but comparatively few tank steamers are carrying oil between Point Sabine and the North Atlantic seaports. The expense of fitting up these vessels has been very heavy, due to the fact that unexpected difficulties developed in the cost of making the installations. This has compelled the owners of the oil steamers to charge comparatively high prices for transportation of the fuel. It can certainly be expected that when a large fleet of vessels are used for carrying oil and when terminal storage facilities are provided that there will be a material decrease in the price of oil in the leading cities on the coast. This is a very important commercial phase of the question, and should be carefully considered in determining the probable relative value of the two combustibles in the early future.

It is undoubtedly a fact that the transportation charges per mile for oil at the present time are excessive compared with the freightage for coal, and this incongruity of expense account against oil cannot continue much longer.

As regards the question of supply, it may be more expensive if not difficult to transport and to store oil than coal. The fumes of all petroleum compounds have great searching qualities, and therefore extreme precaution will have to be taken to guard the storage tanks. If it be true that for military purposes it is best in time of war to keep all reserve fuel afloat, then liquid fuel is at a disadvantage in this respect. The mining and railroad companies have invested so heavily in the coal industry, and the transportation facilities have been so perfected, that it is now possible to quickly deliver a cargo of coal at any point in the world. There has been, likewise, a development in the method of loading and unloading cargoes of coal. Since it will require progressive development to perfect the transportation and the storage of oil, and as the world's supply is still an unknown quantity, it will be some time before there may be a reserve supply of oil at the principal seaports.

It must also be remembered, when considering the problem of supply, that the naval vessel must be kept in readiness for orders to proceed at any time to any port within her steaming radius. The merchant vessel steams between regular seaports, where it would not be difficult to induce merchants to keep a supply of oil as soon as there is a regular and constant demand for it. The question of supply for battleships and cruisers may therefore not only be a commercial affair, but prove to be a military problem, since the oil requirements of naval vessels for service conditions might only be met by the Government establishing oil-fuel stations. The military aspect of the question may prove to be a serious problem, since it not only necessitates heavy expenditures, but it may involve the greater question as to the wisdom of maintaining a complete chain of fuel stations between country and colony.

Third. While the engineer may be most interested in the mechanical features and the shipowners in the commercial aspect, the constructor will meet with difficulties in solving the structural problem relating to the installation of oil fuel on board ship.

The structural feature of the battleship may prove a serious detriment to the installation of an oil-fuel appliance. The problem of storing oil on board war ships which possess protective decks is much more complex than the problem of its storage in vessels of the merchant marine. Everything on board the battleship is subordinated to making the vessel a gun platform. There are many more compartments in the war vessel than in the merchant ship.

In all probability the great bulk of the oil in the war ship would have to be kept in the double bottoms. As the petroleum vapors are quite heavy, it may be a difficult matter to free these compartments of explosive gases, especially when the compartments are partly empty. By reason of the great number of electrical appliances in use on board the war ship, thousands of sparks are likely to be caused, any one of which might cause an explosion and set the oil fuel on fire. Our limited experience with submarine boats may give us an object lesson as to the liability of hydrocarbon gases to explode.

In the merchant service the oil is often stored in expansion tanks or trunks which rise to the height of the deck, and on some of the vessels there is a cofferdam around these tanks so that any leakage of oil can be quickly discovered. It is also a comparatively easy matter to free such tanks of any dangerous gases that may accumulate. Inspection of the tanks at all times can also be readily accomplished.

In view, therefore, of the more difficult conditions under which the oil will have to be carried in the naval service, the structural features are certain to have an important bearing upon the question as to whether or not an oil installation is possible in large ships of war.

The Bureau is not inclined to be pessimistic in regard to the successful solution of the problem. It believes that it is expedient to frankly state the difficulties that are likely to be encountered, so that every means can be considered for overcoming them.

The Bureau has no hesitation, however, in declaring that in view of the results already secured by the liquid-fuel board an installation should be effected without delay on at least a third of the torpedo boats and destroyers. The junior officers of the service are very much interested in the matter, and if several boats are equipped entirely with oil-fuel appliances, a spirited and keen but friendly rivalry will be created which will result in a material increase in the efficiency of the torpedo-boat flotilla. Such an installation would also permit a competition to be established between the boats using coal and those using oil, and this would be another incentive to cause systematic and careful study of the subject upon the part of all connected with the topedo fleet.

The data which have been secured by the liquid-fuel board will be exceedingly appreciated in maritime and industrial circles. A careful analysis of these data will show how complete it is and how carefully it has been collected. Although the experiments have only been in progress for a short time, practically every engineering principle that enters into the oil-fuel question has been touched upon by the board. The tests that have been conducted have been of such a diversified nature, and so many deductions can be made, that other experimenters will now be enabled to ascertain in what direction research should be carried on to secure further definite information.

The completeness and character of the experimental plant has probably never been surpassed, and it is due to this fact that the data collected will command attention in the engineering world.

While the information secured may not hasten the introduction of oil as a fuel in armored cruisers and battleships, it will materially increase oil-fuel installation in ships of the merchant marine and in shore establishments.

It is the engineering or mechanical feature which is of commanding importance in the industrial or mercantile marine world. The structural disadvantages which are so serious as regards naval development will only be encountered in a less degree in ships of the mercantile marine.

The structural disadvantages that may prove so serious in the Navy will not be encountered in the installation of liquid fuel appliances in shore establishments. The insuring of a reserve supply of the fuel ought also to be an easy matter for industrial plants. It should therefore be understood that the naval problem is distinct unto itself, and that while the experiments so far conducted show that an installation on a battleship is a serious problem, the tests also prove that for manufacturing purposes crude petroleum is in many respects an incomparable fuel.

Probably not over a fraction of 1 per cent of the oil used as fuel would be consumed by the Navy; and therefore, while further investigation may be necessary to show the adaptability of oil for large war vessels, the tests already conducted will be of great value and afford considerable information to all present consumers of liquid fuel, as well as to those contemplating the installation of oil-fuel appliances.

The engineering information which is being obtained by the liquid-fuel board will secure increased efficiency of the motive power of the naval stations in the future and also conduce to the benefit of the torpedo-boat flotilla. It will also afford another illustration of the manner in which the industrial world has been aided by naval experimental research.

The data collected during the official oil tests should be compared with the results secured under the same boiler when coal was used. The evaporative efficiency, as well as the ability to force the boiler with two kinds of fuel, can thus be compared and the engineering advance that has been made of late can best be appreciated. It will be mainly by reason of the fact that this comparative data is obtainable that important conclusions can be drawn from the information already secured.

The Bureau submits a copy of the report of Lieut. Ward P. Winchell as to the performance of the steamer "Mariposa" when using oil exclusively under her boilers in making the round trip between San Francisco and Tahiti.

The Bureau also submits a copy of the preliminary report of the liquid-fuel board.

(To be continued.)

POST OFFICE STATISTICS.

The Third Assistant Postmaster General has issued a pamphlet entitled "Postal Statistics of the United States from 1775 to 1902," in which many interesting facts will be found, pertaining not only to our modern mail system, but also to the first postal service in this country.

In 1789 there were only seventy-five post offices established, the length of the post routes being 2,275 miles and the gross revenue of the department being only $7,510. The expenditures for the same year were $7,560 and of this only $1,657 were paid in salaries to postmasters.

There were in 1901, 76,594 post offices in operation, 511,808 miles of post routes, 466,146,059 miles of mail service performed. The gross revenues of the department were $111,631,193, the expenditures $115,039,607, and $19,113,590 were paid as compensation to postmasters.

From June 30, 1847, to June 30, 1851, 4,603,200 postage stamps were issued, while in the single year 1901 4,329,273,396 stamps were used by the people of the United States.

In 1853, the year in which stamped envelopes were first issued, 5,000,000 were used, while in 1901 the total was 772,839,000.

The first year's issue of postal cards—1873—numbered 31,094,000, while in 1901, 659,614,800 were issued.

The registry system was started in 1855, and in that year the registered pieces numbered 629,322. In 1901 they numbered 20,814,501.

In 1865 money orders to the amount of $1,360,122 were issued, while in 1901 the total amounted to $274,-546,067.

The number of pieces of matter of all kinds mailed increased from 500,000 in 1790 to 7,424,390,329 in 1901.

RESTORATIVE POWER.

Whoever watches the healing of a wound stands face to face with the greatest of all wonders, the mystery of the genesis and dissolution of life. The healing process is nothing but a phenomenon of regeneration, a natural process of replacing destroyed tissues by new ones. Regeneration is the general law of which the healing of wounds is but a specific part.

Regeneration of tissues is constantly going on in the human body and certain tissues are renewed even when they are not destroyed by external violence. The nails of our fingers are completely renewed in four or five months, those of our toes in twelve months. Our eyelashes are replaced by new ones in 100 to 150 days, and it takes but four weeks to completely renew our epidermis.

The cornea of the human eye is constantly undergoing a renewing process and is kept clear and clean by the soft friction of the eyelids. But that is not all. Millions of minute cells are ever coursing through all parts of our organism, penetrating to the deepest seats of life, constantly renewing the exhausted tissues and infusing new life into them. Those minute bodies are direct descendants of that wonderful and mysterious original cell from which all human and animal life must have sprung. Those microscopic bodies

which form the millions of white cells or leucocytes in the human body, are ever present and ready to renew exhausted or destroyed tissues, to overcome dangerous tendencies and to ward off dangers threatening the different organisms. They take up the fight against destructive bacteria, produce antitoxic agents, stop hemorrhages by secreting coagulating ferments, carry nourishment to the remotest tissues from the glands of the digestive organs, eliminate discarded, useless and foreign matter, are ever at work building new tissue and striving to maintain the normal condition of the organism.

Wherever organic life is maintained and restored it owes its maintenance and restoration to that power of renewing used-up tissue, which can be traced back to the original cell. That power is not existing in all animals and plants to the same degree. It seems to stand in an inverse ratio to the individualization in the type of animal or plant.

The less an animal varies individually from the type, the less it differentiates in its characteristics, being nearly the representative of a species, the greater is its power of restoring lost parts.

Spiders and crabs have no difficulty in regrowing feelers, legs or shears that have been lost. Snails grow even parts of the head with feelers and eyes again after they are lost. The tails of fishes grow again, should they be cut off by accident.

Nature rebuilds the entire tail end of salamanders and lizards, including the bones, muscles and even parts of the spinal cord, and in the case of young lizards a lateral incision into the tail may even cause the formation of a second tail. The restorative faculty of certain lower animals like the medusa, pleuaria, infusoria, etc., is almost unlimited.

The restorative power of man is exceedingly limited as compared with that of the lower animals. In fact, the healing power of wounds is all that has remained to man of that wonderful restorative power of lower animals. Cicatrization, or the healing of wounds, is a process so complicated and involving so many reproductive and problematic elements, that it is of great interest to investigate it.—Surgical Clinic.

APPARATUS FOR SHORT-DISTANCE STEREOSCOPIC PHOTOGRAPHY.

Stereoscopic apparatus are generally constructed for the reproduction of objects of large dimensions. They are not well adapted for the photographing of small objects, which, in order that they may appear on a proper scale upon the negatives, have necessarily to be photographed at a very short distance.

When the object to be photographed is quite close to the stereoscopic apparatus that is to reproduce it, several difficulties are encountered: (1) The images of the central part of the object separate farther and farther (one to the right and the other to the left) from the centers of the two halves of the sensitized plate designed to receive them, so that one of the negatives contains the left half of the object and the other the right half. The part common to the two negatives (the only one for which the relief appears) is then reduced to a band that becomes narrower the closer the object is to the lenses. The width of this band may even descend to zero if the photograph is taken at a sufficiently short distance. We then have a negative which evidently cannot be used in the stereoscope. Fig. 1 gives the appearance of such a negative.

The object is a watch movement photographed at a distance of six inches by the aid of a verascope. (2) Another difficulty even before this limit is reached, however, is met with. In the printing of the positive, which, as is well known, necessitates the immersion of the two right and left negatives, the changing of center of the corresponding points of the two objects still remains, but in the opposite direction. The distance that separates these points upon the positive print becomes less than the distance between the eyes, so that when this photograph is placed in a stereoscope with lenses of equal focus to that of the photographic apparatus, the two eyes have to make an effort toward convergence that becomes greater in proportion as the changing of center is greater. The result is an increasing difficulty, and even the impossibility of obtaining a stereoscopic superposition of the part common to the two negatives.

In order to avoid such an inconvenience, it might occur to us to separate the two positives from each other in contrary directions so as to increase the distance of the corresponding points of the two images and consequently to diminish the effort of convergence of the eyes. But this mode of operating, aside from the fact that it would in no wise remedy the first difficulty pointed out, would involve, in the apparent form of the object in the stereoscope, an alteration such as has been studied in detail by M. Cazes.* Such alteration consists in a progressive increase in the apparent thickness of the object as compared with its transverse dimensions. Such an increase in thickness would become exaggerated along with the lateral displacements that the two images were made to undergo, and, consequently, in proportion to the distance at which the exposure was made. We should then soon have, at short distances, objects appearing to have a thickness twice greater than their real one, as compared with their height and width dimensions. Upon the whole, through such a procedure, we should end at an increasing development of the relief that would soon become exaggerated and not acceptable in practice.

With the collaboration of M. J. Richard, says M. E. Colardeau, in La Nature, I have combined an optical device which, while correcting the first defect, likewise permits of decreasing the second in a systematic manner so as to give a practically satisfactory relief.

The photographic apparatus, P (verascope, for example), Fig. 2, is placed upon a support, $S S'$, which is capable of sliding along a guide, $R R'$, so that it can reach the desired distance from the object to be photographed. The support, $S S'$, is formed of two parts, one of which, S, may be raised or lowered with respect to the other, S', by means of a rack and a controlling button, B, placed laterally. In this way, it is possible to regulate the height of the apparatus. The object to be photographed is situated at C. It may be suspended from a vertical board, as shown in the figure, or be placed upon a shelf affixed to the board. Since the board may be displaced horizontally, with the object that it carries, along the slot, D, it is possible to regulate the position of the object widthwise.

The most interesting parts of this stereoscopic apparatus are the two transverse slides, $E E'$, fixed to the guide, $R R'$, and the two disks, $F F'$, carried by the board, $G G'$, that serves as a support to the entire affair.

The two disks, $F F'$, are traversed by two axes of rotation, $H H'$, placed eccentrically not far from the edges of the disks. It is, therefore, possible to turn them around these axes and to fasten them in any position whatever by means of two binding screws, $I I'$, so that the space they leave between their two internal opposite edges shall be more or less wide. The posterior extremity of $R R'$, guided by E, can then be displaced to the right and left to a distance that varies with the space that exists between the disks.

As for the front extremity of $R R'$, which is very near the object to be photographed, that owing to the slide, E', may likewise be displaced to the right and left. Two screws, $V V'$, regulate the displacement in such a way that it shall be equal to that which separates the two objectives, $O O'$, on the front of the camera (about 2.5 inches). Let us suppose the guide, $R R'$, to be placed on the left side against the screw, V, and the disk, F. The axis of the objective, O, will then be directed toward the center of the object to be photographed, if the screw, V, is properly regulated. If, then, we make a first exposure, with this objective, O', while closing O with a small swinging shutter, L, we shall have the right hand negative perfectly centered upon the corresponding part of the sensitized plate.

This first negative having been taken, let us shove $R R'$ on the right side so that it shall abut against both the screw, V', and the internal edge of the disk, F'. This time it will be the axis of the left hand objective, O, that will be divided toward the center of the object. Now let us close the shutter on the objective, O', and make a second exposure with the left hand objective, O. We shall then have the left hand negative, upon which, in its turn, the centering will be effected. When we print a positive with these two negatives by the ordinary methods, the object will therefore be perfectly centered upon the two halves, right and left, of the print; and, when we place the whole in a stereoscope, we shall have, without any abnormal effort to converge the eyes, an optical superposition of the two images in their entire extent.

Geometrical considerations into the details of which we cannot enter here, show that at the time of the two exposures made with the objective, $O O'$, the latter work with a fictitious spacing less than that which separates them upon the photographic apparatus. Such spacing is so much the less, for a given distance of the object from the objectives, in proportion as the spacing between the two internal edges of the disks, $F F'$, is greater. It results from this that the degree of relief obtained in the stereoscope will be so much the greater in proportion as the space between the edges of these

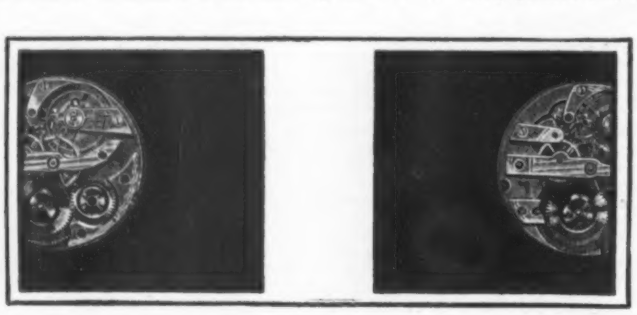


Fig. 1.—CHANGE OF CENTER EFFECT PRODUCED UPON A STEREOSCOPIC PHOTOGRAPH TAKEN AT A SHORT DISTANCE (6 INCHES).

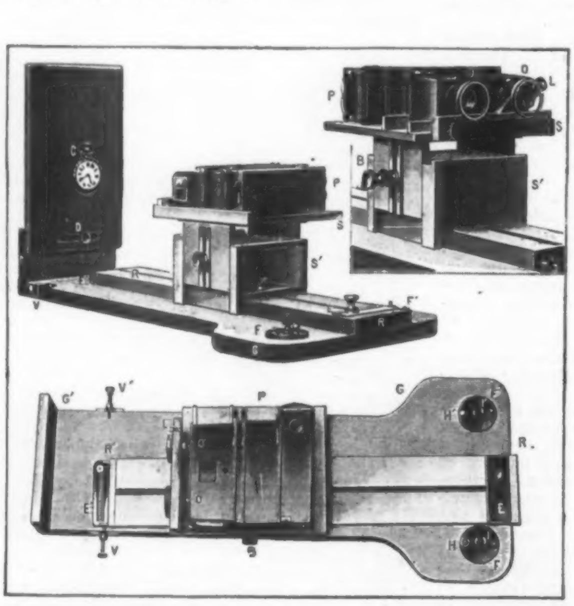


Fig. 2.—APPARATUS FOR STEREOSCOPIC PHOTOGRAPHY. PERSPECTIVE AND PLAN VIEW.

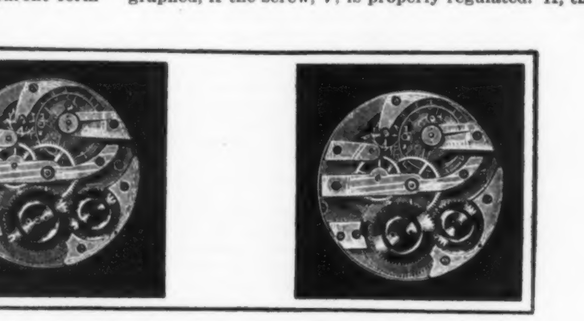


Fig. 3.—STEREOSCOPIC PHOTOGRAPH OF A WATCH MOVEMENT WITH CORRECT RELIEF.

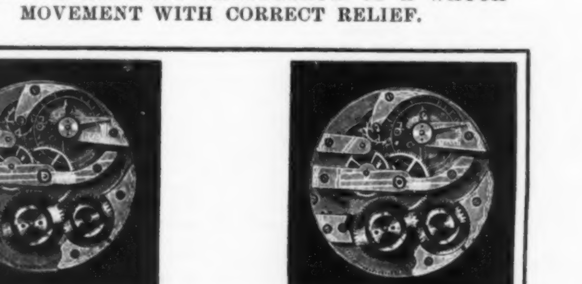


Fig. 4.—THE SAME WITH EXAGGERATED RELIEF.

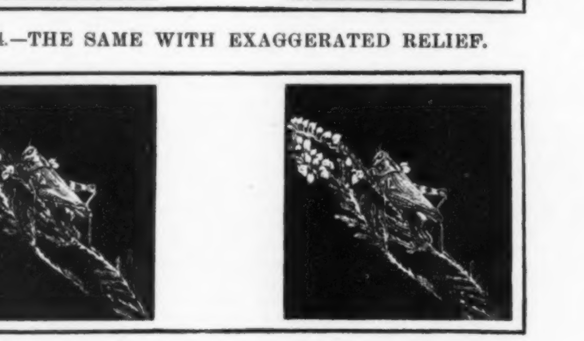


Fig. 5.—STEREOSCOPIC PHOTOGRAPH OF A GRASSHOPPER TAKEN AT A DISTANCE OF 6 INCHES BY MEANS OF A VERASCOPE.

* Stereoscopie de precision, L. Cazes, p. 23.

two disks is smaller. Were this space such that the posterior part, *R*, of the guide displaced itself, like its anterior part, to a degree equal to the real spacing of the objectives, *O O'*, the latter would occupy exactly the same position in space at the moment of the two exposures. Then the two negatives, right and left, would be identical, and the relief null. Upon the whole, if, with this instrument, we take a series of stereoscopic photographs of the same object, while continuously narrowing the interval between the edges of the disks, *F F'*, such photographs will present a degree of relief systematically increasing from zero to a maximum value that will be greatly exaggerated if the length of the guide is not too great.

In this manner, by the aid of a verascope, I have taken a series of ten negatives of the same watch movement at a distance of six inches with regularly decreasing spacings of the disks, *F F'*. These negatives, examined one after another, give the illusion of a watch which, while preserving a constant diameter, shows a thickness varying from zero to several fractions of an inch. Among these negatives, one gives the illusion of the true thickness of the watch. This is the one that was obtained with a spacing of the disk, *F F'*, corresponding to a fictitious spacing of the objectives equal to about .25 of an inch. We give herewith a reproduction of two of these photographs. Fig. 3 corresponds to the correct relief, and Fig. 4 to the exaggerated relief.

Such a series of negatives with variable relief is particularly interesting to examine when they are made to pass along rapidly in a binocular cinematographic apparatus. We then have the illusion of the continuous thickening or flattening of the object.

Instead of trying always to reproduce stereoscopically the true thickness of the object, it may prove of interest with certain subjects to diminish or increase such thickness. We may succeed in doing this by changing the position of the two disks, *F F'*, while bearing in mind that approaching them tends to exaggerate the apparent thickness of the object, and separating tends to diminish it. For example, if it is desired to reproduce a medal, the reliefs of which are very slight, we must diminish the distance between the disks, *F F'*, so as thus to obtain a photograph that will give reliefs and depressions more pronounced than those of the medal itself. In like manner, in a mechanism of complicated and delicate structure, such as a watch movement, it might prove of interest to exaggerate the apparent thickness, so as to permit the eye to see the position of the assembled pieces of the mechanism more distinctly, one behind another.

We have just seen that the apparatus under consideration is especially designed for photographing small objects at a short distance. It is then necessary to pay attention to the focusing of the images furnished by the two objectives, as such images form further back of the objectives in proportion as the object is nearer to the front of them. In bellows apparatus, it is through the variable extension of the bellows that the images are made to form always upon the sensitized plate. But in the majority of hand apparatus now in the market, the sensitized plate is placed once for all in the focal plane of the objective, and the apparatus is regulated for infinity. Practically, the apparatus is in focus for all objects comprised between infinity and a distance of a few yards from the apparatus. When it is desired to take a photograph at a shorter distance, we adapt supplementary convergent lenses to the objectives.

The arrangement that I employ utilizes the two combinations at the same time. I annex to the verascope three interchangeable lengthening frames that are interposed between the camera and the plate magazine. These frames have thicknesses equal respectively to .39 of an inch, .78 of an inch, and 1.56 inches, so that by employing them separately or in pairs, or by uniting all three, seven different lengths of conjugate foci are obtained. Fig. 2 shows the verascope provided with two of these frames.

Besides, it is possible to provide the objectives with either convergent or divergent supplementary lenses, each of which, with the frames, gives seven new combinations of foci. With three frames and a few pairs of lenses, we have thus a number of combinations that permit of reproducing a subject of any size whatever on a proper scale.

The possibility of obtaining stereoscopic negatives of small objects at a short distance by means of a simple and easily manipulated apparatus considerably extends the field to those who are occupied with this sort of photography. A simple flower, a blade of grass, a jewel, an insect, a mineralogical specimen, a medallion, are some of the many subjects that abound around the amateur and that may furnish him material for interesting negatives which he will contemplate with that peculiar pleasure that stereoscopic relief always produces, even in those to whom it is nothing new. In Fig. 5, by way of example, we give a reproduction of a photograph of a grasshopper standing upon a sprig of heather, at a distance of but six inches from the lenses.

Let us add, for the benefit of those that are bold enough to enter upon the photography of colors (by the trichrome method, for example), that it is especially in objects of small dimensions that they will find a host of subjects. In order to take, one after the other, the three negatives necessary for the production of colored positives, it suffices to annex the three colored screens to the photographic apparatus employed. Under such conditions, I have very easily obtained good negatives, which, to the charm of stereoscopic relief, add that of color.

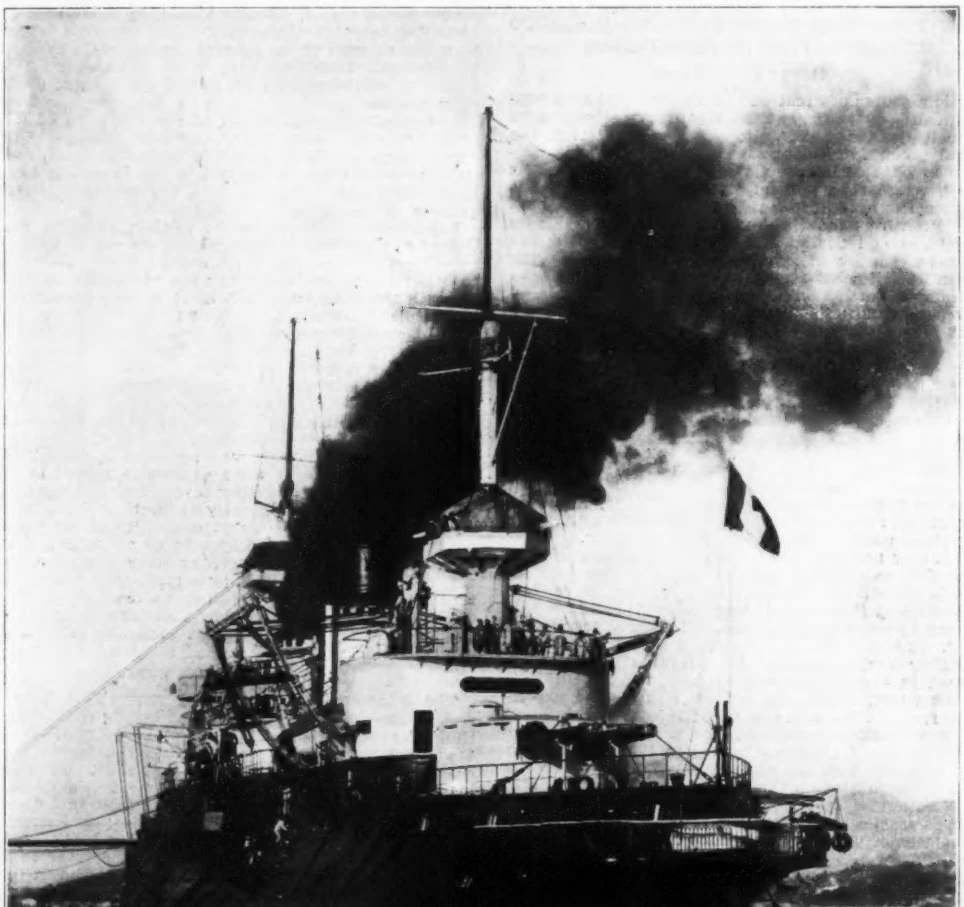
Finally, with the apparatus that has just been described, nothing is more easy than to reproduce a stereoscopic negative, of any size whatever, in the proper size for the apparatus that the operator possesses. In this manner I have reduced to verascopic size, a series of negatives of the usual commercial size, and even 5 x 7 inch size, the majority of which were radiographic negatives obtained by means of X-rays.

It is no less easy to extract an interesting detail (such as the head of a person, in a group) from a stereoscopic negative by enlarging it so as to make it occupy the entire extent of the field. With this object in view, it suffices to employ all the elongating frames, together with sufficiently powerful converging lenses to permit of making a copy of the subject at a few fractions of an inch distance.

THE FRENCH FIRST-CLASS BATTLESHIP "GAULOIS."*

THE class of vessels to which the "Gaulois" belongs is a notable one in many respects, and among others for the fact that in these vessels the French designers for the first time abandoned the "quadrilateral" method of carrying the heavy guns, in which each of the four pieces forming the main armament is carried in its own separate turret, one turret being forward and one aft of the superstructure, and one on either beam amidships. For some years before these vessels were built, our own Navy and the British Navy had followed the plan of housing the main battery in two turrets arranged on the center line of the vessel, one forward and one aft, a method of disposition which had the advantage of separating the main battery and giving it the widest possible arc of command. The "Charlemagne," "St. Louis" and "Gaulois," as the three vessels of the class are termed, are in the main excellent vessels, although they suffer from two rather serious defects, namely, that the secondary battery is too light, mounting only 5.5-inch guns, where present practice runs to the 6.4-inch and 7-inch gun, while there is an unprotected stretch of the side of the ship immediately below the upper deck which is unprotected by armor. We think it is likely that in some future programme of reconstruction these two defects will be eliminated, the 6.3-inch gun being substituted for the 5.5-inch, and side armor being placed over the unprotected area referred to. The dimensions of the "Gaulois" are, length, 383¾ feet; beam, 66¾ feet; and draft, 28 feet. The displacement is 11,260 tons and the complement 631 tons. The armor consists of a continuous belt which is 15¾ inches in thickness amidships and tapers in thickness toward the ends. There is a 2¾-inch flat deck at the top of the main belt, and also a 1½-inch splinter deck. The armament consists of four 12-inch guns carried in barbette turrets which are protected with 16 inches of armor. The hoists to these guns are protected by 12 inches of armor. The intermediate battery of ten 5.5-inch guns is but poorly protected, having only a wall of 4-inch armor in front of it with ?-inch screens between the gun positions in the battery. In addition to the 12-inch and 5.5-inch guns, there are eight 4-inch, twenty 3-pounders, and ten 1-pounders, besides eight Maxims. There are four submerged torpedo tubes and two above water. The ship is driven by triple screws and steam is raised in twenty Belleville boilers fitted with economizers. On a twenty-four-hour trip, the "Gaulois" indicated 13,400 horse power and made a mean speed of 17.7 knots and on a four-hour, full-power trial her engines indicated 14,963 horse power and drove her at a mean speed of 13.2 knots. The normal coal supply is 680 tons and the maximum bunker capacity 1,100 tons; but this is supplemented by a certain amount of liquid fuel. It will be noticed from our view of the ship that the "Gaulois" has the characteristic "tumble-home" of the French ships, and like them she has a lofty freeboard, the after pair of guns seen in our illustration being carried about 9 feet higher above the waterline than the after pair on our own "Illinois" and "Maine," while the forward pair are carried at an elevation of about 32 feet above the sea, or about 8 feet higher than the forward guns on the "Illinois." This question of freeboard is one to which French and Russian designers have paid great attention, and there is no question that in heavy weather the high command of the guns will prove to be a valuable feature, as the interference by intervening waves will be reduced in such ships to a minimum.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.



Displacement, 11,260 tons. Speed, 18 knots. Maximum coal supply, 1,100 tons. Armor: Belt, 15¾ inches; gun positions, 16 inches; deck, 2¾ inches and 1¼ inches. Guns: Four 12-inch, ten 5.5 inch, twenty 3-pounders, and ten 1-pounders. Complement, 631.

FRENCH FIRST-CLASS BATTLESHIP "GAULOIS."

FAILURE OF VOLAPUK.

THE opening up to trade of remote regions and the extension of civilization among barbarous people have called the attention of scientists to the need of a universal language which all may understand. There are to-day hundreds of different languages and dialects spoken in the four quarters of the globe. No one has mastered them all and few persons, comparatively speaking, know any other tongue than that of their parents. Those to whom a knowledge of the principal languages is essential are travelers, merchants engaged in foreign trade, and professional linguists.

A universal language—one that may be written and understood by all the human family—has been the dream of linguists for a hundred years. Various artificial languages have been invented to answer this purpose, the most notable being the "Esperanto," devised by Prof. Zamenhoff of Moscow, and "Spelin," by Prof. Bauer, of Agram, Croatia. Both failed to become popular. As the result of the experiments that have been tried from time to time in this direction, it has become the general opinion that the world will not take up any artificial language until it is fully adopted by the English-speaking nations.

The attempt made to establish Volapuk as a universal language has, I am sorry to say, been a failure. Despite the efforts made by some of the leading linguists to create wide interest in the subject, the experiment did not result as we had hoped it would. The failure was due to the fact that the percentage of those who really need to know several languages besides their own is not yet sufficiently large to insure the success of a universal language.

Volapuk was the most practicable artificial language that had been devised for the purpose. It was invented by the Rev. Johann Martin Schleyer of Con-

stance, Germany, a celebrated linguist, and he worked out the vocabulary and other details more thoroughly than most of his competitors, so that it was an actual language in working order. It was found to work all right in practice, but not enough people could be found who were willing to devote their time to its mastery to make it a success.

The trouble was that Volapuk was from fifty to a hundred years ahead of its age. I am satisfied that some such universal language, greatly improved upon, perhaps, will one day be adopted by the leading peoples of the earth.

The Volapuk experiment was the most notable ever tried, either here or abroad. Thirteen years ago, when it was at the height of its popularity, no less than 265,000 persons had become familiar with the speaking and writing of Volapuk, and 150 societies had been formed for its propagation. While it was strong in Germany, Austria, Spain, France, Italy, Sweden, and Denmark, in the United States there were only 6,000 students of the new language.

Perhaps the chief reason why Volapuk was not taken up more extensively here was that our young men had not the patience to master a language that was not then in general use. They felt that French or German or Spanish was much more practical, and therefore much more desirable.—Charles E. Sprague in The Washington Times.

SOME PRACTICAL SUGGESTIONS ON MOSQUITO EXTERMINATION IN NEW JERSEY.*

By HENRY CLAY WEEKS.

It is a source of great encouragement that this commonwealth of yours, whose vigorous methods have made its justice stand quite alone in reputation, the varied product of whose soil and mines, its manufactures and its commerce make it a peer among great states, whose rare, natural attractions, as well as its public spirit have drawn a very substantial part of its population from those who naturally belong outside its borders, should be the first to take legislative action against a common enemy. This, indeed, is encouraging and in line with her reputation. It remains to be seen whether this action will be followed up by other necessary action until the State becomes, as it may, freer from these evils than some others which it has combatted. There is no better method to accomplish this end than discussion and education, and the introduction of the subject which your worthy body has now for the first time, as is learned, decided upon, is to be hoped will be a most potent factor in the educational plan.

HISTORICAL REFERENCE.

It was long years after it was announced that by the reclamation of marsh lands for commercial purposes, as in the English fen country over a century ago, mosquitoes had been lessened, before any efforts were made to reclaim marshes simply to reduce the pests.

It is now nearly a century since it was suggested in a London publication that oil might be used to diminish mosquitoes. Probably that was not the earliest suggestion of the idea. It was followed during a half century by many confirmations, but nothing resulted of it all. It was a long period until a school boy in Central New York, interested in natural history, experimented in destroying "wigglers" by using a little oil on the water, but it was not until that same experimenter, about ten years ago, published the results of his later work of destruction on a larger scale, that attention was generally attracted to the idea, coming as it then did from one who represented the knowledge of the government on the subject—Dr. L. O. Howard, of Washington.

The æsthetic idea of getting rid of them by the improvement of unsightly situations comes with the new century.

So, in the other phase of the subject, it was a score of years after Dr. A. F. A. King suggested the theory that malaria was borne by mosquitoes, that any systematic efforts were made to exterminate them and thus reduce malaria—the exact experimentation in the meanwhile showing in a most marvelous way the correctness of this suspicion. And the same delay in practical results followed the suspicion that yellow fever was transmitted by mosquitoes. Last year was the first in two centuries that Havana was free from a case of yellow fever, and that, after the destruction of the breeding places of *Stegomya Fasciata*—definitely proven to be the source of transmission of that scourge.

THE ANTI-MOSQUITO HABIT.

It all simply means, what is true in many other realms, the slow growth of great ideas and improvements. As Thomas B. Reed recently said at the centennial of Bowdoin College, "Not only must wisdom be arrived at, it must be crystallized into habits for the good of all."

In this, as in all other cases, the first reformers have been the subjects of much ridicule, and it has taken a store of courage and persistence to make any impression on the public attention. It is a hopeful sign that some papers which were much inclined to be facetious are now seriously interested. And so the battle has been and must be waged in all lines, equally against the learned with the unlearned.

And though the cases are rapidly growing less, there are still a few weaklings who think the task too great. The campaign must still be pressed until the domestic habits, the commercial habits, the sanitary habits, the engineering habits, will be as much against causing or maintaining breeding places as is sentiment against any habits that would cause any other plague. And this will only come by carefully holding all that has been gained—losing nothing by ill-considered action—and the extension of the area, gradually but surely. It is encouraging that the president of the board of health of the great metropolis is doing what he can in this campaign and already has put into the field a number of experts.

One of your speakers—a distinguished worker in the cause—in a letter recently, expressed the fear, which has been felt all along, that many will go into schemes of extermination with only the faintest ideas of the necessities of the case, will meet inevitable defeat, and thus the good cause will have a strong reaction not to be overcome in many years—all this unless the people are well informed on the subject. Anyone who thinks the campaign easy work, mistakes the enemy and the situation. The habits of the nation have to be completely changed and then the victory is won and hardly before.

Whereas, for instance, the acts of engineers have often been the cause of great trouble, study will avoid this cause; as in railway and highway construction by not blocking watersheds; in street improvements, by first caring for water before streets are filled in around low places, and thus through all engineering work.

An instance is in mind where a railroad was so run across a lake as to form a pool without outlet. This space has been found breeding malaria-bearing *anopheles* in vast numbers.

In a report on conditions and remedies on the north shore of Long Island, in 1901, the speaker referred to a driving road proposed to be built in a certain section, and even described in detail how it should be constructed to obviate mosquitoes. Since then the road has been constructed and in entire disregard of the suggestion, and to-day comes to hand the report for 1902 of the entomologists engaged in that territory, which says: "Undoubtedly the worst natural exposure in the whole territory (about 50 square miles) was along the eastern side of the new road to the beach at Lattingtown. Somebody, in building that road, committed an error that is no less than criminal, for the pools formed there, on account of the natural drainage being cut off by the road, breed not only *culex* but *anopheles* in almost as great numbers per square foot as was physically possible."

Instances will occur to all of the extension of city streets so as to inclose water, in which situation it becomes most excellent breeding grounds. New York city has acres thus conditioned in the Bronx, in Long Island City and elsewhere, with the necessary consequences of discomfort and ill-health.

Landscape architects, public officials, farmers, gentlemen owning country seats, physicians—in fact everyone—must cultivate the anti-mosquito habit. Educated to believe in their danger and the possibility of their extermination, all must talk of it as well as practise their belief, whether in public or private spheres. The decided change from incredulity or even opposition to strong belief, which will result from this course, was most clearly noted in a certain section where theory and practice have combined in the light of a successful experiment on Long Island, before referred to. And so the work will grow, for nothing exterminates like extermination.

The advance of science has noted some remarkable changes of views, none more so than in regard to the causes of malaria and yellow fever; and this advance, when understood, has greatly strengthened the anti-mosquito habit. The plain practicability of the means used in doing this work appeals to all who are informed. It impressed the speaker many years ago, and enforced rest has afforded an opportunity latterly of renewing the thought and writing on the subject. And everyone who accepts the now indisputable proofs of danger from the pests is called to a like mission of extermination.

IMPORTANCE OF THE WORK.

The question of exterminating mosquitoes from a section also implies so many other results than simple riddance, that it is not thought to be overstating the case to say that it is one of the most far-reaching economic questions of the day. Foremost comes the increased healthiness of the section—its relief from the most insidious disease, malaria, or from that dreaded scourge, yellow fever. The physical and mental dejection of a malaria-ridden people for the devastation that comes of an invasion of yellow fever is beyond description. It has been too clearly shown that these ills may be avoided by exterminating the mosquito that instances will not be cited before this well-informed body.

Another result comes in the improved conditions resulting from the bread-winners of a malarial section being able to employ all their time at work, instead of suffering the loss of a large proportion of the year by actual illness and the loss of vigorous life. The loss, actual and incidental, to some communities from malaria in one year would accomplish all the relief work that would banish it forever from their midst.

Again we have the physical improvement of the land reclaimed through exterminating operations, and this now worse than worthless land throughout the country amounts to an almost incredible area. Shaler estimates the salt area of the United States to be over 12,000,000 acres, and the lacustrine swamps, not including boggy lands, to be about 25,000,000 acres. To turn this vast area from pestiferous conditions to productive conditions means the addition of many billions of wealth to the country.

The resultant effect on neighboring values adds another equally large element of importance to extermination by reclamation.

And what has been more recently acknowledged as an important consideration, namely, public comfort, also applies with great force in this movement. Though some varieties of the enemy may not actually cause disease, the discomfort they all cause is beyond estimate.

And then comes what is important in its way, the æsthetic results, the improvement of foul breeding places, often right within the line of residence areas. Population and values increase with attractive and healthy surroundings and in every aspect imaginable there is a general betterment.

It is doubted whether more than two other economic reforms of the country can show an array of material and other advantages equal to this.

If one is a benefactor who makes two blades of grass grow where before but one grew, another is equally so who causes no mosquitoes where formerly millions grew. And anyone who does this needs no greater monument than the gratitude of a once-suffering but relieved people. It is to be hoped that your excellent society may earn such a monument through its present action in opening this discussion.

The speaker some months ago gave, in the SCIENTIFIC AMERICAN, a statement of some of his conclusions concerning the mosquito plague which he now ventures to repeat as giving briefly his earnest views:

I. Every mosquito found in a district is an indictment against the public spirit, the progressiveness, the intelligence, or the persistence of the people of the district, except in instances so rare as not to affect the statement.

II. Every case of malaria, not a relapse or an importation into a district, is evidence of avoidable crime against humanity in some or all of its interests, and against the fair fame of some of the most beautiful sections of the land.

III. That in greater degree than smallpox is malaria a crime, for the latter reaches more persons and its effects are more pervasive. Some high authorities are urging the imprisonment of smallpox patients as criminals.

And when these ideas are fully realized and acted upon your State will begin a new era of development. On the other hand it is the sincere belief of the speaker that if this State allows other sections to get in advance of her along the fighting line, her population and standing as a place of residence will be seriously affected.

There is a movement, largely educational so far, it is true, but still having a successful practical side, going on along the hilly north shore of Long Island which is attracting great attention and bids fair, if continued along suggested lines, to lead to a great increase in population, and the movement of this new population must affect other sections adjacent to the metropolis. Probably no point will be affected more than near sections of your State. The future of Long Island has so impressed the greatest railroad management of the world that it is spending many millions of money in making it convenient by tunnels, etc., for New Yorkers to make that island their home. And it will be but a short time before New Yorkers doing business in the Metropolis and living in your State will be able to drop themselves and their household goods down into a tunnel on the Jersey side and have all shot through to Long Island most conveniently. And this will most surely be the result unless you can say, as Long Island hopes to say before long, "no mosquitoes; no malaria." A recent convert, a man of large affairs, lately said that he believed both of these troubles would be extinct on Long Island in ten years, to which the speaker responded, "It can be so." If your State presses the battle she will hold her own, but not otherwise.

CHANCES OF FINAL SUCCESS IN NEW JERSEY.

The question naturally arises, Can the mosquito be exterminated from a whole State? The confident answer is, "yes," if the fight is well planned and pressed. The simple extension of the successful work carried on over a limited area will accomplish precisely the same results. The State is densely enough populated to demand that all breeding places be obliterated, and that means success for the whole State.

It also requires, as before stated, an education of the public and a willingness to spend a large amount of money—no, not large when results are measured; indeed, an amount only that would be returned to the State within three years of the proclamation of liberty. Firm but fair legislation must be planned to aid in the movement or it will be seriously retarded by those who are incredulous, careless or contrary.

Long-held theories of night air, of miasma, of air from fresh excavations and all that long list are being fast exploded, though such creations are generally long-lived. This rapid change of view as to the true cause of malaria will greatly help you. And though your legislators will be facetious as at the last session, nevertheless they will grant the necessary funds if the cause is rightly put and the money appropriated shows results. Your arguments to reclaim all the breeding places are greatly strengthened by the fact that no part of your State is beyond easy access to large centers of population, so that every acre reclaimed could be profitably utilized for residential or agricultural purposes.

For many years the speaker has regularly read what has so strongly been set forth by your most efficient State geologists and their coadjutors on the subject of drainage and reclamation. The theme has been more interesting than any romance, and why all the successive yearly presentations have not had more effect is a cause of great wonder. Of course, many of the reports were made before the compelling argument of healthfulness had attained, as now, its strongest force. The State now must listen to those who officially present this matter. Its wastes, salt and fresh, must be redeemed, not only because to do so is profitable and attractive, but pre-eminently because the greatest boon to a community—good health—demands it. For forty years your State geologists have urged action toward reclamation, and the visits abroad of Professors Cook and Smock resulted in arguments that should have produced great benefits to the State. After Professor Cook's visit to Europe he closes his report on this subject, thirty-two years ago, thus: "Mosquitoes and green-headed flies, those pests of our salt marshes, would certainly find a less favorable breeding ground if the water was all drained from the surface, and this of itself would be a great saving to the community. I saw a few gnats [Eng. for mosquitoes. W.] in the English fens, none in Holland. . . . Such lands are by far the most profitable and productive of any I have seen abroad."

And yet, looking at New Jersey's problems as compared with those of the countries visited by him—England and Holland—the task is a simple one to redeem its wastes and exterminate its mosquitoes. For instance, you have no situation where it will ever be required to reclaim and cultivate valuable land twenty feet below sea level, as in some cases in Holland.

In 1892, before the cause of malaria was known, Professor Smock said: "Looking to the ultimate development of all our natural resources, and the removal of the unsightly and malaria-breeding wastes . . . the need of some carefully-planned and judiciously executed drainage projects on our tidal meadow lands is of great importance and is much to be desired."

THE FRESH WATER SWAMP PROBLEM.

By its geological formation New Jersey offers a somewhat difficult problem in the reclamation of some of its

* Paper read at Lakewood, N. J., October 25, 1902. At the Twenty-eighth Annual Meeting of the New Jersey Sanitary Association.

interior swamps, and these must be reclaimed to solve the mosquito question. For instance, with quite parallel ranges of mountains in the northern part, there have been formed water surfaces between and beyond them with scarcely enough opportunity of outlet to relieve the situation. And this difficulty has in some cases been increased by the works of man. It will readily be conceded that the water of the Passaic basin forms the greatest menace as fresh breeding areas in the State. Several swamps of thousands of acres here occur, and if not already they will, slowly, as is usual, but surely become the habitat of anopheles until in their entire vicinities malaria will become endemic.

That "Lake Passaic" existed at one epoch with an area 30 by 10 miles, stretching from east to west from Morristown to the second Watchung Mountain, and from south of Millington about to the New York line, seems most certain. At any rate this area now presents a problem, in the midst of valuable residence property, as left in this condition at a later epoch, with its difficult outlet and its scattered water surfaces.

The efforts at relief here have been long continued and as yet are only partly successful. The statement is thought to be correct that if even all works planned are carried out still relief would not be had for many extensive marshes of the Passaic and its tributaries. A third of a century ago some of these marshes were surveyed and reported upon, and yet they still exist. By reason of the long, but slightly descending course of some sections of its bed, large areas are flooded constantly and still more are flooded by freshets so as to render them useless for cultivation and worse than useless as forming breeding ground.

Though there is an elevation of 230 feet above tide at Great Swamp, there is a descent of only about one foot a mile in the Passaic and its tributaries for about 20 miles, in a large part of that distance it being substantially level. In fact, from its source to Little Falls the descent is only a fraction over one foot to a mile. To overcome this would seem to be well-nigh impossible and yet thus to reason is not in the spirit of the age. Some thoughts in this connection must be reserved for fuller consideration and study of data, but, as far as considered, it is thought that this whole section could be relieved by State action and these vast interior swampy breeding grounds be eliminated and conditions of better health and living prevail, waste lands made cultivatable and even habitable, and a great economic and financial benefit to the State result.

You have a fresh swamp area of vast extent; just what, your geologist could not say, little of which has been redeemed for cultivation. Take, as an example, the Great Meadow with its 5,500 acres of black muck about 5 feet deep; it offers an investment for capital almost beyond the dreams of avarice of any farmer.

In New York State there was some twenty years ago a situation that will illuminate our dream. A swamp near a village was claimed to be the source of an epidemic of malaria; why, was not then known. At some distance was an abandoned canal, deep enough to drain the swamp. This idea was urged, the State did the work, the swamp was effectively drained, malaria shortly disappearing. The swamp was cleared of growths, put under a state of cultivation for vegetables, particularly onions and celery. It was stated many years ago that this worse than useless land was then paying ten per cent net on a valuation of $1,000 per acre. The speaker purposely made inquiries a few days ago as to present income and found that that statement of returns still held true and that $50 an acre only had been the cost of redemption. The tract is now cultivated by several farmers who are making farming pay. Your State has thousands of acres of equal opportunity and but limited cultivation is as yet practised. These lands must be secured against inundation and this must be the work of the State under plans, a discussion of which time limit excludes. A low estimate of increase in the valuation of these lands would be $100 per acre. Net results of 10 per cent, as has been quoted, would warrant the statement of increase to be $1,000 per acre, but at $100 the State would have an increase of valuation of many millions of dollars.

But these material considerations, as vast as they are, are not urged as, by any means, the greatest result to be accomplished. When it is realized that these great wastes are the congenial habitat of mosquitoes, quite generally of the malaria-bearing anopheles, and when it is realized that the direct and indirect misery and loss caused by this disease are beyond a financial showing, then does the transcendent importance of action become manifest.

THE SALT MARSH PROBLEM.

As in the case of the interior swamp problem, we take up a single instance of coast marsh, that which is more familiar to most of us, namely, the Newark and Hackensack meadows. The treatment of one section, however, is not the proper thing for all, for in few realms will the skill of the engineer be more required than in meeting the differing conditions. No part of the salt marsh problem is more intricate than the withstanding of tides. Studied for centuries in Europe, made a government work, untold millions of money expended, there has resulted a fund of information and skill not realized here.

Your geologists estimate that the State has about 300,000 acres of tidal marshes, or one-eighth of its farm land, and further, considering the extra fertility of these marshes if reclaimed, that there would be an addition of 20 per cent or more to your farm products. Of course, subsidence of some of these reclaimed lands has rendered automatic drainage inoperative, but it would seem that in your cases of reclamations, two centuries old, profitable resort could be had to pumping. Some efforts at reclaiming a section of the Newark meadows began about forty years ago, but were not crowned with final success. Some plans which have been proposed by your Geological Survey for relief of this entire section are most interesting and brilliant. But the conditions, to the speaker's mind, demand more authority and means and a still more radical treatment than can be commanded by any private movement. The lack of success noted above and the efforts to induce further reclamation, so far unsuccessful, point to the need of further consideration by the best authorities in the lines involved, engineering, legislation, financiering and what not, and a concentration of effort on what may be decided upon.

The speaker has long had in mind some relief plans which he has not had the opportunity or time to confirm by data, which has not been suggested so far as he has noted. Some such plans would seem to solve the difficulty. Surely advanced thought must find some way of overcoming the great menace to values, to health, to appearances, to all conditions which prevail in this great waste area of 27,000 acres. When it is shown to be advisable, and there is expended $25,000,000 in improving the Nile; when Chicago builds a canal forty miles long, costing $33,000,000, including interest charges, to improve conditions; when the great Pontine marshes (by Italy's government) are to be reclaimed at vast cost; when individual enterprise spends millions in engineering projects; surely a State of the resources of New Jersey ought to carry out, and that speedily, some means of relief for the great problem that is presented in these marshes within the constant view of so large a part of the metropolitan area.

But I may not encroach upon the subject of the speaker who is to follow.

A few days ago the writer stood with the correspondent of the Brooklyn Eagle and the New York Times, which papers have taken a great interest in this subject, at the edge of what was two years ago, an impassable salt marsh infested with mosquitoes and presenting an unsightly waste in close proximity to one of the finest estates on Long Island, or even in the country. That day were seen growing as fine celery as one could wish, turnips measuring sixteen to eighteen inches in circumference, a fine field of rye, another of timothy, besides other crops; and in some other parts were seen the great breaker plow, drawn by specially shod horses, turning over in perfect furrows some more of the rich land which as yet had not been mechanically or chemically subdued. This has come about, as it may with your hundreds of thousands of acres of salt marsh, by a firm conviction and the pressure of that conviction against the opposition of nature, of ancient sentiment, and all else. In the case referred to, the owner himself experimented under many discouraging circumstances, had much of his work to do over and over again, laid out a large amount of capital, but under later hands is working out his cherished ideas, and is gaining one of the finest features of his vast enterprise. That day but a single mosquito was found in traversing the entire marsh.

In conclusion, and briefly, Organize! Let every community where mosquitoes and malaria prevail, organize. Much can be attained in this way that is not possible by individual action. The movement on the north shore of Long Island, to which reference was heretofore made, is the result of organization; not organization specifically for mosquito extermination in that case, but that as coming under the beneficent objects of an association of men the peers of any in the land in any respect; men who thought the mosquito problem not too great, nor yet too small for them to attack. Locate all the causes of your troubles, the nesting places of mosquitoes and malaria; let competent experts be kept in the field all summer; determine whether the places located are breeding anopheles; ask all your physicians to report the sections where malaria prevails; note, as did the above mentioned movement, the exact concurrence of the two evils; candidly inform the people, irrespective of any fear of injuring a section, of the fact and the cause of the fact; urge legislation if existing laws do not meet the case; ask State help where the proposition is too large for towns; let eminent domain have full play; appoint committees, organize meetings and lecture courses; lead public sentiment, and raise funds. No festering sore is cured by throwing a mantle over it; expose it to the bone, if necessary, and clean it out. Let considerations of humanity, the bettering of the conditions of all classes, especially the poor who are most affected by these evils; let these bravely prevail. Having located the enemy, attack him with the vigor you would attack any other scourge. Plan methods of relief carefully and carry them out thoroughly. To be less than thorough means defeat and a setback for the principles of the warfare. Whether the action refers to the spraying with oil of a pool a foot square or the drainage of the wet lands of an entire State, let it be done, as it may be done, thoroughly, and victory is as sure as any martial victory ever was. The instances are now too numerous for anyone to question this; and the call is to every one in the State: Enlist, enlist!

COTTON SEED RENDERED IMMUNE.

The United States Department of Agriculture has been making experiments for the purpose of ascertaining whether "wilt" or "black heart" could not be prevented in cotton. It is said that seed has been obtained which is totally immune to these disasters. Work has been carried out on the line of "breeding," the seed being carried up to the highest quality of healthfulness by careful cultivation. Prof. Orton says that the experiments show that the only hope of the farmers in getting rid of the disease, where it has once gotten a foothold, is by the use of immune seed. The disease is said to be of fungus origin and remains in the soil, to make its appearance after seven years, the land having been planted with other crops in the meantime.

Prof. Orton regards "black heart" as the deadliest enemy of cotton, and one with which farmers cannot afford to trifle. If allowed to go unchecked he thinks it will, in a few years, ravish the sea island cotton fields, as it has the upland fields in some sections of Alabama and other cotton-growing States.

Prof. Orton also had an experiment in planting Egyptian cotton, which was tried in this section this year, but the result leads to the conclusion that the Egyptian staple is not adapted to the soil and climate of this section. There appears to be too much moisture, producing a large, woody plant, with little fruit upon it. The tests that have been made in Texas and along the Mexican border are said to have been much more satisfactory.

RECLAIMING SWAMPS.

A great deal of northern Minnesota is about as flat as a floor. Over a wide area east of the Red River Valley the water partings between the streams are scarcely perceptible. Many of the streams meander in tortuous courses sluggishly over the prairie and lose themselves finally in big marshes. Some of the rivers, as shown on the maps, appear suddenly to terminate just as rivers are marked on maps of deserts where the streams are lost in the sands.

According to the New York Sun a number of these large marshes are not far from the Red River Valley. It is proposed to dig some long ditches to lead the waters of these now sodden and worthless lands into the valley. The Lost River ditch will be four miles long, and will drain 22,000 acres of swamps; the Badger ditch will be eight and a half miles long, draining 5,300 acres; the New Solum ditch will be four miles long, draining 1,000 acres; the Goodhope ditch, five miles in length, will also drain an important area.

The total cost of these four ditches is estimated at $26,500, and they will turn 30,000 acres of swamp lands into the richest of fields and meadows, adding most appreciably to the productive area of the State and improving the health conditions in that part of the country. The contractors have already begun the work on these important improvements.

THE LORENZ OPERATION.

The New York Medical News, in its current number, publishes the following description of the Lorenz operation:

"This bloodless method of reduction in the treatment of congenital dislocations at the hip may be described briefly as follows: The thigh is strongly abducted and the adductor muscles are torn from their attachment by chopping or sawing with the edge of the hand. This must be complete, as this group of muscles prevents the superabduction so necessary to keep the limb in place after it has once been reduced. After the muscles are torn through, the limb is stretched to pull the head down to the level of the acetabulum. When this is reached, the thigh is flexed and extended vertically upward, at the same time making pressure behind upon the trochanter so as to force the head forward. Then, still keeping the hand or wedge beneath the trochanter, to act as a fulcrum, the leg is abducted and the head slips over the posterior rim of the acetabulum with a distinct snap. The head is now in the acetabulum, but has no tendency to stay there, and becomes redislocated as soon as one attempts to straighten the limb. To overcome this, the hip is reduced and redislocated several times, the joint is rotated, and pressed in so as to bore out the acetabulum. In cases of greater difficulty, Lorenz attempts the reduction over the upper rim, which consists of making traction upon the thigh by means of a skein of yarn slung about the leg and pulled rhythmically by several assistants. The use of the screw for this purpose has been given up on account of the danger of fracture. The leg must be rotated inward to guide it to the acetabulum, while counter traction is made by means of a perineal band.

"The physical signs accompanying a successful reduction are easily demonstrated and cannot be missed. The leg becomes as long as its normal companion, the hollow Scarpa's triangle becomes filled up, and the head can be palpated beneath the femoral muscles. The knee becomes flexed from shortening of the hamstring muscles. The snap, which is felt and heard at each reduction of the joint, can often be made out by observers several feet away. Upon redislocation all the above signs disappear. The second step in the operation is to turn to use what has been gained in reducing the head. As already mentioned, the head slips into the acetabulum only after extreme reduction combined with flexion and internal rotation has been attained. Any lessening of this extreme position allows the thigh to become redislocated. Therefore, Lorenz fixes the limb by means of a plaster cast in this extreme position, and after the first few days of pain and restlessness pass away the flexed limb is fitted with a high shoe so as to enable the child to bear its weight upon it. In this manner the child is encouraged or rather forced to run about all day on this limb, so as to allow of the functional burdening of the head and acetabulum. This pressure soon digs out a new joint, which is easily demonstrable by means of the X-ray. Crutches are never to be used, for they defeat this purpose. After six months the cast is removed, the leg brought nearer to the horizontal, and a new cast applied. Finally, after eight to twelve months, the cast is taken off altogether, and a high shoe is placed on the sound leg to preserve a small amount of abduction; this, with massage, electricity, and gymnastics."

THE FORESTS OF RUSSIA.

The gradual deforestation of Russia is attracting increased attention throughout the Empire, and the Forestry Society as well as the Forestry Department of the Ministry of Agriculture and Domains are discussing means for regulating the consumption of timber and for propagation. There does not seem to be any great cause, however, for apprehension, as a recent official report states that forests in Russia now cover an area of 188,000,000 hectares (464,000,000 acres). Among European countries, Sweden comes next, with 44,000,000 acres of forests. In Russia the forests cover 36 per cent of the whole area of the country. The Swedish forests occupy 44 per cent of the total area, and the Austro-Hungarian 32 per cent of the territory of the dual monarchy. Reckoned by the population, there are 4.9 acres of forest to each inhabitant of Russia, 9.5 acres in Sweden, 10.4 acres in Norway, and .69 acre per head in Germany. The forests have a greater importance for Russians than for people of Western European countries, as villages and country houses are largely built of wood, stone and brick houses being almost unknown, and the forests furnish the main sources of fuel supply.—Jour. Soc. of Arts.

DISTRIBUTION OF CURRENT AT THE SURFACE OF CATHODES IN VACUUM TUBES.*

By A. WEHNELT.

IF a vacuum tube with metallic internal electrodes is exhausted, the cathode shows the well-known phenomena in the usual succession. The small spot of glow light which first appears on the cathode expands more and more as the pressure decreases, until finally the whole cathode is covered with glow light. On further exhaustion the cathode space, at first narrow and dark, expands more and more. At the same time cathodes, consisting of plane metallic plates at right angles to the axis, and nearly filling the sectional area of a cylindrical vacuum tube, show a crowding together of the canal rays and cathode rays into a sheaf which becomes thinner and thinner. This unequal covering of the cathode surface with visible structures led me to investigate whether the current through the surface of the cathode shows inequalities, or whether independently of the visible structures the current flows evenly through the whole surface of the cathode.

I.—DISTRIBUTION OF CURRENT IN CATHODES NOT COMPLETELY COVERED WITH GLOW LIGHT.

If a tube with a wire cathode is exhausted, the glow light either forms a small luminous gap at the end of the wire, or surrounds the wire cathode at any other place, as shown in Fig. 1. To decide the question whether the current only passes through the portion covered with glow light or through the whole surface, I used the arrangement shown in Fig. 2.

FIG. 1.

The cathode consists of a thin tube of brass, K_2, 0.5 centimeter in diameter, through which a well-insulated brass wire D is led. At the end of the thin brass wire D is attached a piece of thicker brass wire of the same diameter as the tube, and rounded in front. The whole cathode then behaves like a single-wire electrode, except that the front and back portions can be connected separately to earth through a galvanometer. A_1 serves as the anode if the glow light is to appear at K_1, and A_2 if it is to appear at K_2. The experiments carried out with a high-tension battery of accumulators showed that the current only flowed through that part of the cathode to which the glow light was attached. When A_1 was the anode, and the glow light, therefore, only sat upon K_1, then the current only passed through K_1 when the glow light owing to increase in the current strength extended further over the cathode and began also to cover K_2. Whether the glow light is attached to the end of the wire or to any other part of it, it is not sharply defined at the edges, but the dark cathode space clearly becomes larger at the margin, as shown in Fig. 1. The same phenomena as G. Wiedemann has shown also occurs in circular plane cathodes. The middle portion of the glow light lies much closer against the cathode than the marginal portions, as shown in Fig. 3. Modern experiments furnish a simple explanation for this phenomenon.

If in the case of the perfectly covered electrode the intensity of the current is reduced, the length of the Hittorf dark cathode space increases, as shown by detailed experiments made by Hehl at Erlangen, the results of which are shortly to be published. Now, it is very unlikely that the current density at the limit, g (Figs. 1 and 3) of the glow light is suddenly reduced to zero. It is more probable that it gradually approaches zero. Accordingly, the thickness of the dark cathode space at the limit of the glow light must be greater than in the middle.

To decide the question whether, in the case of plane circular cathodes nearly filling up the section of a cylindrical vacuum tube the total current in the vacuum tube flows through the portions covered with glow light, or whether, also, the uncovered portions take part in conducting the current, I used a cathode, K, consisting of a central round disk, S (Fig. 4), and an insulated concentric ring, R, which closely surrounded it. Both the disk and the ring had separate leads and were attached to a plate of mica, which protected the portions lying behind the cathode from discharges (Fig. 5). The surface of the disk S was 1.96 square centimeters, that of the ring 6.33 square centimeters, and therefore the ratio of the surface R/S=3.3.

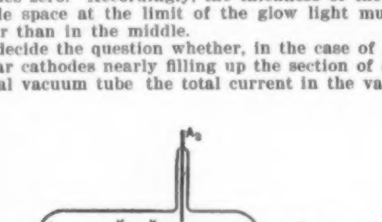


FIG. 2.

With the aid of a mercury commutator, C, a galvanometer, G, could be introduced into the earth connection of one or of the other electrode. The sensitiveness of the galvanometer used was in most cases 1.98×10^{-4} amperes per scale division. In the other branch there was a coil W, of exactly the same size and number of turns as the galvanometer coil. This arrangement was used so that in the case of oscillations, as they occurred later on, in some cases either by themselves or through the introduction of spark-gaps, the condition of inductance and resistance should be the same. That with a continuous-current, differences in the resistances of the current branches played no part, was shown by the complete absence of a change in the current conditions on the introduction of 100,000 ohms in one of the branches. These oscillations, which are only strongly marked in the case of aluminium electrodes, owe their origin to slight impurities of the surface. Cleaning with fine emery paper is of no avail. The surface assumes a dirty, gray color, and the cathode so treated produces strong oscillations. Filing down the aluminium with a clean smooth file is rather more effective. But the most advantageous process was always that of scraping the aluminium with a sharp knife, as used for erasures. After such treatment I have never obtained oscillations except at pressures where the high discharge potential alone would account for them. The source of current was sometimes a 20-plate influence machine and sometimes a high-tension battery of 1,800 accumulators with a tension of 3,600 volts.

FIG. 3.

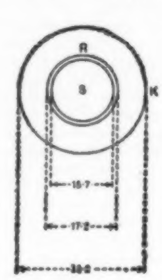


FIG. 4.

If the tube is so far exhausted that only a small patch of glow light is attached to the cathode, the patch shifts hither and thither in the well-known manner. The deflections of the galvanometer show that the current always flows through that portion of the cathode (R or S) on which the glow light happens to be, and that the portion free of glow light shows no perceptible current. If the pressure is reduced to such an extent that the glow light occupies a larger surface, and partly covers the ring and the disk, there is always more current through that portion of the cathode which is more covered with glow light. When the cathode is just completely covered, the ratio of the ring current to the disk current is 3.4, while that of the ring surface to the disk surface is 3.3. The current density on the cathode is, therefore, everywhere the same when it is completely covered with glow light.

II.—DISTRIBUTION OF THE CURRENT AT THE SURFACE OF COMPLETELY COVERED PLANE CATHODES.

While the experiments just discussed have reference to cathodes which are not yet completely, or only just completely, covered, i. e., which are in the normal condition, in what follows I give particulars of the distribution of the current at lower pressures, i. e., under normal conditions. In exhausting cylindrical discharge tubes provided with circular cathodes which are normal to the axis and nearly fill the whole section, it is found that the sheaf of canal rays and cathode rays, which fills the whole tube at high pressures, contracts more and more as the pressure decreases, so that at very low pressures the sheaf only touches the cathode in one point. To decide whether it is only those parts of the cathode which are touched by the rays that conduct the current, or whether any part of the current is conducted by the non-luminous portions, I used the tube shown in Fig. 4 with the plane cathode consisting of ring and disk (Fig. 3).

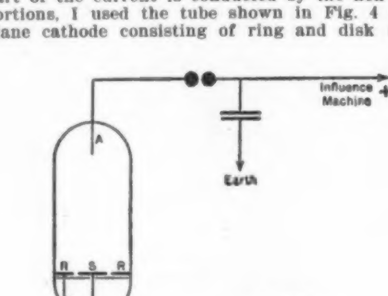


FIG. 5.

At various pressures the galvanometer was inserted either in the lead of the ring R, or in the lead of the disk S, by changing the commutator. The following table contains the current intensities observed at decreasing pressure in scale divisions of the galvanometer. One scale division corresponded to 1.98×10^{-4} amperes. The sum of the disk current and the ring current is always nearly the same, since the influence machine yields a current nearly independent of the external resistance.

It follows from the table: (1) As already shown, the ratio of the current strengths passing through the ring and the disk respectively is 3.4 when the cathode is completely covered, and the ratio of their surfaces is 3.3, i. e., the current density is the same at every point of the cathode. (2) As the visible bundle of rays at the cathode contracts toward the middle, the ring current becomes feebler, until at last at very low pressures, when the canal rays and the cathode rays are reduced to a thin pencil, the inner part of the cathode alone conveys the current, i. e., the current only passes through those parts of the cathode which are covered by the visible rays.

Current through: Disc.	Current through: Ring.	Sum.	Remarks.
28	95	125	Whole cathode covered.
43	88	131	Less than half the ring covered.
101	21	122	Narrow zone of the ring covered.
(140)	(Current reversed)	...	Ring quite free. Strong disturbed discharge.
127	0	127	Thin sheaf in the centre of the disc.

At a certain pressure, which varies according to the circumstances, strong oscillations suddenly appear in the tube owing to the causes above mentioned. The disk current is in this case stronger than the total current furnished by the influence machine, while a feebler current flows in the opposite direction through the ring, so that the external portions of the cathode behave as an anode with respect to the central portions. To investigate the distribution of the current during these oscillations, the condenser was inserted, or a spark-gap with or without a condenser. Fig. 5 shows the connections. By forming the connections shown in dotted lines in Fig. 4 at the commutator, the total current of the influence machine could be conducted through the galvanometer. Then the tube was exhausted so far that at first a continuous current passed through it. Thereupon the pressure was so regulated as to make the oscillations as strong as possible. In both cases the distribution of current was first measured without a condenser and then with a condenser.

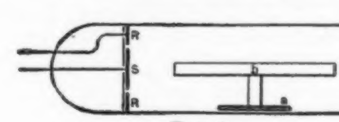


FIG. 6.

The following table contains the results:

I.—CONTINUOUS CURRENT.

A.—Without a condenser at the tube:

Total current J=67 divs.
Disc current i_s=67 „
Ring current i_r= 0 „

i_s+i_r=68 „

B.—With a condenser:

Total current J=79 divs.
Disc current i_s=75 „
Ring current i_r= 2 „

i_s+i_r=77 „

II.—CONTINUOUS CURRENT.

A.—Without a condenser:

Total current J= 76 divs.
Disc current i_s= 110 „
Ring current i_r= −33 „

i_s+i_r= 77 „

B.—With a condenser:

Total current J= 74 divs.
Disc current i_s= 191 „
Ring current i_r= −119 „

i_s+i_r= 72 „

Similar phenomena were observed on introducing a spark-gap.

The tables show that in the case of a non-continuous current the distribution of the current is very different from what it is in the case of a continuous current. While in the latter case the current distributes itself accurately in the ratio of the luminous surfaces of the ring and disk, in the former case not only do the ring and the disk convey currents in opposite directions, but of these currents one or both may have a higher numerical value than the undivided current. But if the current in the opposite direction be regarded as negative, the sum of the two currents has the same value as the main current. That really a current passes in a direction contrary to the normal current is clearly seen by the positive light which appears on the ring. Not only in the ordinary alternating current, but also in the continuous current, cases occur in which the current is stronger in each branch of the divided circuit than the main current. But the algebraic sum of both currents is, of course, equal to the main current. The above experiments have determined the distribution of current in cathodes in the case of an undisturbed discharge. To test the conclusion that the current always flows through those parts of the cathode which are touched by the luminous rays, the point of contact was shifted to other parts of the cathode either by a magnet from without or by deflection from within. If a strong magnetic field is made to act upon the cathode rays, it is found, as shown by E. Wiedemann and H. Ebert, that the point of contact of the canal rays and the cathode rays on the cathode is displaced, and is converted into an elongated oval. According to the above results this implies a change in distribution of the current. As a matter of fact, when two insulated semi-circular plates of aluminium were employed as an electrode, it was found that under the influence of a strong magnetic field by far the greatest part of the current passed through that portion which lay

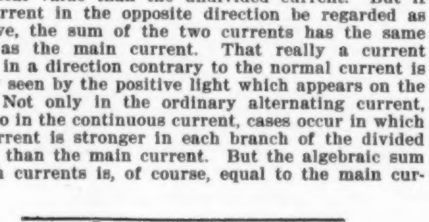


FIG. 7.

* Translated from Ann. der Physik.

in the direction of the deflection of the point of contact of the canal and the cathode rays. If insulators or conductors are introduced into the dark cathode space it is well known that an enlarged shadow of the body appears on the cathode in the layer of canal rays, i. e., the canal rays and cathode rays and their points of contact with the cathode are pushed asunder on the cathode. If, for instance, in the tube shown above (Figs. 4 and 5) a glass rod, *b*, attached to a small piece of sheet iron, *a*, is pushed along the axis toward the middle of the cathode, the point of contact on the cathode forms a ring between the glass rod and the wall of the tube. The thickness of the glass rod *b* (Fig. 6) was so chosen that at the pressure at which the whole current passed through the disk *S* the point of contact of the rays was crowded from the disk on to the ring *R*. Under these circumstances the galvanometer showed that the current then no longer passed through the disk but through the ring.

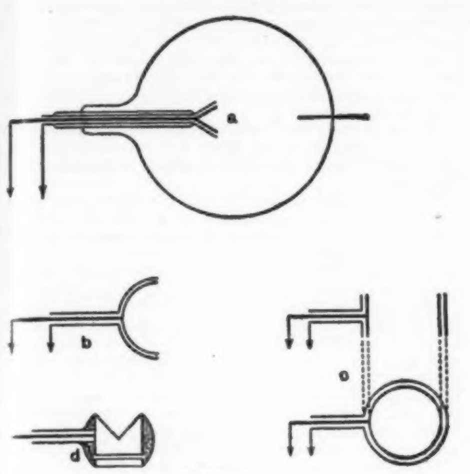


FIG. 8.

The result of the above experiments led me further to test whether the cathode rays also only proceed from the luminous part of the cathode, or whether they have their origin on the whole surface of the cathode. For this purpose a cylindrical tube with a circular cathode, *K*, was exhausted so far that only a thin bundle of canal rays and cathode rays was visible. Into the path of the rays were brought three wires D_1, D_2, D_3, parallel to each other, and indicated in Fig. 7 by black points, together with a screen, *S*, placed at a small distance behind and covered with Balmain's luminous paint. The wires and the screen were rigidly connected and attached to a small piece of sheet iron. With the aid of a magnet this arrangement could be displaced in the tube from outside. Two measurements were made at a distance, *d* equal to 7 centimeters and 5.2 centimeters, respectively from the cathode. The distance *a* between the wires D_1 and D_2 was 0.72 centimeter, and the distance *b* between D_2 and D_3 was 0.6 centimeter. The distance *c* of the wires from the screen *S* was 5 centimeters.

d.	*e.*	*f.*
I. 7cm.	1·22cm.	1·33cm.
II. 5cm.	1·07cm.	1·16cm.

The distances between the shadows on the screen are given in *e* and *f*. Now, if x denotes the distance at which the point of intersection of the cathode rays, as calculated from the position of the shadows, lies in front or behind the cathode surface, the following four values are obtained for x: 0 centimeter—0.6 centimeter, 0.7 meter and 0.1 centimeter. The experiment shows clearly that the luminous point of the cathode is also the origin of the cathode rays, for the small value of x, which also changes in sign, must be attributed to

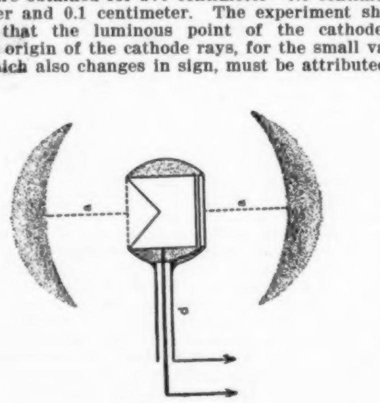


FIG. 9.

small errors of measurement. Therefore, the place at which the current passes through the cathode is also the origin of the cathode rays.

III. DISTRIBUTION OF THE CURRENT AT THE SURFACE OF CURVED CATHODES.

In curved cathodes, the cathode rays emerging from the interior appear distinctly brighter than those proceeding from the outer portions. This gives an impression as if more cathode rays proceeded from the hollow space than from its walls. In what follows, the question is investigated as to whether this is due to a greater current density from the interior, or whether secondary causes (deflection) produce a crowding together of the cathode rays into a small space and thus an increased visibility of the rays. Hollow electrodes of various forms were used in which the interior and exterior portions were carefully insulated from each other and provided with separate earth connections. A galvanometer could be inserted as before into either of the two earth connections. To avoid the influence of the walls, the cathodes were always in the center of a large spherical vessel about 15 centimeters in diameter (Fig. 8*a*). The cathodes used had the shapes shown in Figs. 8, *a*, *b*, *c*.

In the electrodes *a*, *b*, *c*, the interior current, i. e., the current flowing through the internal portion, was always equal to the exterior current, i. e., the current flowing through the external portion, as soon as the glow light completely covered the electrode. This rule was not broken, except when the dark space became large. But if the pressure was reduced so much that a vivid fluorescence appeared on the glass walls, the discharge was in all these electrodes crowded out of the inner space, so that eventually the interior became less than the exterior current. An electrode of the form Fig. 8*d*, consisting of a solid cylinder with a conical boring at one end and an insulated thin plate of the same diameter on the other end, arranged so that both the cylinder and the plate had separate leads, was used to determine how much the current flowing through the hollow space decreases at very low pressures. Every portion, like the leads and the mantle of the cylinder, was insulated with sealing wax. The following table gives the current flowing through the funnel and the surface in scale divisions of the galvanometer at decreasing pressures:

Funnel.	Plane.	Funnel.	Plane.
42 divs.	26 divs.	36 divs.	33 divs.
42 „	26 „	36 „	33 „
40 „	28 „	34 „	34 „
38 „	32 „		

The ratio of the currents at the higher pressures, but with the hollow electrode completely covered, was 1.6, and that of the surfaces was 1.68. The former is therefore equal to the latter. At lower pressures the ratio of the current densities approaches more and more to unity, so that eventually only the aperture of the hollow cathode determines the current. The hollow electrode at low pressures behaves toward the current as if there were no hollow, but only a plate of the same sectional area as the aperture. The greater brightness of the cathode rays coming from the hollow electrodes is therefore not caused by a stronger current in that region, but only by a stronger crowding together of the cathode rays by deflection.

The explanation of this fact, which at first sight ap-

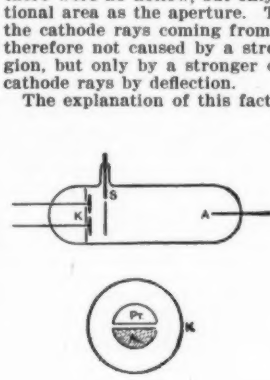


FIG. 10.

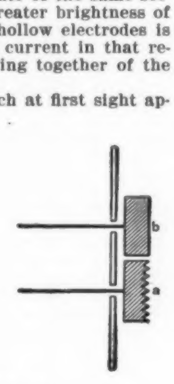


FIG. 11.

pears somewhat surprising, is very simple if one assumes that the same quantity of electricity flows through the unit of surface at the limit between the glow light and the dark cathode space. For if the limit of the dark cathode space is examined at somewhat lower pressures (Fig. 9), it is seen that this limit is almost entirely plane for the funnel-shaped opening of the cathode—that is to say, the separating surface between glow light and dark cathode space is similarly shaped and of the same size in the case of a plane and the hollow cathode. But from this it follows, according to the above assumption, that the amount of electricity flowing through the flame and through the funnel must be equal, and this is fully corroborated by the experiment.

IV. INFLUENCE OF THE MATERIAL AND THE SURFACE CONDITION UPON THE DISTRIBUTION OF THE CURRENT BETWEEN TWO PARALLEL CATHODES.

(*a*) Influence of the cathode fall of potential at various metallic surfaces upon the distribution of the current.—I investigated whether the differences observed in different metals in the cathode fall of potential, as described by E. Warburg, has an influence upon the distribution of current in discharged tubes, whose cathodes consist of two different metals. In a discharge tube, Fig. 10, was mounted a cathode, *K*, consisting of two semicircular plates. Their diameter was considerably smaller than that of the discharge tube, so as to avoid the influence of the walls. The two plates consisted of different metals, such as platinum and aluminium, and were carefully insulated from each other by a thin strip of mica and had separate leads. Immediately behind the cathode was a large plate of mica filling the whole section of the discharge tube, so as to protect the leads lying behind the cathode from the current. About 8 millimeters in front of the cathode was a platinum probe, *S*, which passed through the center of the tube, and remained parallel to the line of division of the two plates (in the upper figure, the cathode is turned through 90 deg. in order to show the arrangement of the plates). One of the cathode halves always consisted of a polished platinum plate, while the other consisted in turn of aluminium, iron, zinc, copper, and silver. As already mentioned each earth connection of the two cathode halves could be put through a galvanometer.

I only give those results in full which I obtained with a cathode consisting of platinum and aluminium in an atmosphere of hydrogen. I chose aluminium since, according to Warburg, its cathode fall of potential in hydrogen strongly differs from that of platinum, thus giving the most decided difference. Magnesium, which possesses a still lesser cathode fall than aluminium, was not at my disposal. With a gradually decreasing pressure the cathode falls of the walls were measured separately, then together, and from the moment at which the discharge passed through both plates the current passing through each half of the cathode was measured.

The following table contains, for the experiments in hydrogen, in the first column the pressure in millimeters of mercury, and in the three following columns the cathode fall of potential of aluminium and platinum alone, and of both together. The fifth and sixth columns contain the current intensities flowing through aluminium and platinum. For the measurements of potential I used a Warburg electrometer as modified by E. Wiedemann and G. C. Schmidt.

Cathode Gradient and Current Distribution at Al and Pt at different Pressures.

Pressure.	Cathode fall.		Al + Pt	Current through	
	Al	Pt		Al	Pt
0·15	(652)	> (700)	647	81	51
0·4	475	557	458	84	43
0·6	395	510	380	89	36
0·78	348	480	342	93	33
1·1	302	416	302	105	0
1·8	282	353	266	...	...
2·1	277	342	258	...	...
3·5	269	329	255	...	...

The following results are taken from the above table: (1) If a cathode consists of two metals having different cathode potentials, the whole cathode fall of potential is equal to that of the metal having the lowest cathode fall. (2) The current distributes itself in such a manner that at least at the higher pressures by far the largest portion flows through the metal with a smaller cathode fall of potential. At lower pressures and greater dark spaces the difference disappears more and more. This is due to the fact that with large dark spaces the influence of the material of the electrodes is less prominent—that is to say, the percentage influence of the fall of potential at the cathode itself disappears beside the great abnormal fall.

The potentials given for a pressure of 0.15 millimeter do not represent the total fall at the cathode, since at that low pressure the dark cathode space had extended far beyond the probe.

The other metals tested showed qualitatively the same behavior, but quantitatively they had smaller differences, since their cathode falls of potential do not differ so much from that of platinum as in the case of aluminium. I give as examples the measurements made with platinum and iron and platinum and lead in hydrogen and in air:

Pt *and* Fe *in* H.

	Pressure.	0.6	0.34	0.2
Current through	Pt	51	59	62
	Fe	74	64	62

Pt *and* Fe *in Air.*

	Pressure.	0.2	0.1	0 06
Current through	Pt	27	33	31
	Fe	35	35	32

Pt *and* Pb *in* H.

	Pressure.	0.7	0 37	0.2	0.1
Current through	Pt	34	35	38	38
	Pb	44	42	40	38

Pt *and* Pb *in Air.*

	Pressure.	0.26	0.14	0.1	0.013
Current through	Pt	38	38	36	35
	Pb	32	35	35	35

The metals were tested, as I said, in hydrogen obtained by electrolysis, since, according to Warburg, the differences in this gas are specially marked. But measurements in pure nitrogen show the same phenomena, except that, in accordance with the small differences in discharge potential, the differences in the current were also smaller. The distribution of current between platinum and lead in hydrogen corresponds to their cathode falls of potential, but in air the reverse is the case. But then the differences are so slight that they may also be due to accident. That the potentials are higher than those given by Warburg is due to slight impurities in the gases. It was of great importance to keep the electrodes clean and polished, since otherwise the results show great variations. Such variations were especially strong in the case of aluminium, but they influenced the current more than the cathode fall of potential.

With small dark spaces, the smaller one was always attached to the wall possessing the lesser cathode fall, and which, therefore, conveyed the chief part of the current. This corresponds to the fact that an increase in the current reduces the dark cathode space.

The first, probably, to observe such differences in the thickness of the dark cathode space was W. Crookes. He saw that when a disk-shaped cathode was half covered with lamp black, the dark space at that portion was considerably larger than at the polished portion, probably owing to the distribution of the current.

(*b*) Influence of the surface condition upon the distribution of current in the cathode.—The aluminium electrode, consisting of two semicircular pieces insulated from each other was studied in the same tube as before. One half of it was polished with fine emery paper so that its surface was a dirty gray, while the surface of the other was scraped with a knife. The surfaces of both electrodes were nearly equal in size. It was found that the potential gradient in both halves was equal, but the current through the scraped electrode was much stronger than through the gray one. The following table shows the distribution of current at different pressures. The current intensities are given

in scale divisions of the galvanometer (1.98×10^{-6} amperes):

Pressure in mm.		1·66	1·32	1·03	0·81	0·63	0·41	0·13	0·063	0·027
Current through	Al rough ...	6	10	19	46	46	49	55	53	58
	Al pure......	113	110	98	76	74	70	64	57	56

Here also the differences in the conduction of the current disappear at low pressures. Of two equally large and equally thick semicircular aluminium electrodes the one a was provided with grooves as shown in Fig. 11. Since the surface was larger than that of the plane electrode b, the stronger current passed through a at pressures at which the cathode was just completely covered with glow light. With greater dark spaces the currents flowing through both halves were exactly equal which again shows that at lower pressures only the projection of such surfaces upon the plane determines the current.

Results.—1. When the cathode is not completely covered with glow light, the current only flows through those portions which are covered with glow light.

2. In cylindrical discharge tubes with circular cathodes normal to the axis at low pressures, the current only passes through those portions to which the rays are visibly attached.

3. The visible point of attachment of the rays at the cathode must be regarded as the origin of the cathode rays.

4. In current electrodes (funnels, spherical cathodes, etc.) the current densities at the inner and outer surfaces are equal when the cathode is completely covered with glow light. At low pressures, in spite of the greater brightness of the visible cathode rays emerging from the interior, the current density at the interior surface is smaller than on the exterior. With decreasing pressures and increasing dark spaces the current distribution at the cathode is more and more regulated by the rule: "The current density is the same at all parts of the limiting surface between the glow light and the dark cathode space." The current density at the different parts of the cathode itself is determined by the portion of the limiting surface which corresponds to it. Since, in the hollow cathode, nearly equal portions of this limiting surface correspond to the exterior and interior surfaces, it follows that the current intensity in both is equal.

If a discharged tube contains two cathodes of equal surfaces but different metals in parallel, the current flows through the metal having the lower potential gradient as soon as it is completely covered with glow light. At low pressures this difference disappears more and more, since in the dark spaces the high gradient in the gas exceeds the gradient at the metal.

WHAT THE UNITED STATES OF AMERICA IS DOING FOR ANTHROPOLOGY.*

HAVING recently had the good fortune to pay a somewhat extended visit to the United States of America, I have thought it might not be uninteresting to you to hear what our kinsmen and colleagues across the Atlantic are doing for the furtherance of anthropology.

The means for the advancement of the science of anthropology fall under the following heads: (1) The collection of information in the field; (2) the publication of such information; (3) the collection of specimens; (4) the preservation of specimens; (5) the publication of museum specimens; (6) the instruction of students; (7) independent investigation of collected material.

As no hard and fast line can be drawn between some of these activities, I shall deal first with the museums and with the field work undertaken by the more important institutions in the United States of America, and then very briefly with the teaching of anthropology in the United States.

I. FIELD WORK AND MUSEUMS.

It is a glory to the nation of the United States that it has recognized the duty of collecting information about the aboriginal Americans. The twenty or more annual reports published by the Bureau of Ethnology constitute a monument to the intelligence of the government and of its departmental officials of which their country may well feel proud. Nor does the Bureau of Ethnology neglect the collection of specimens, as is evidenced by the very extensive collections transferred to the National Museum. I cannot, however, refrain from remarking that it seems very strange that the anthropography, or physical anthropology, of the native tribes is entirely neglected by the Bureau, and I know that others share with me the hope that this state of affairs will be remedied.

The head curator of the department of anthropology in the National Museum, Dr. W. H. Holmes, is gradually working out his conception of what his museum should be. His object is twofold: (1) to illustrate the cultural history of mankind; (2) to demonstrate the distinctive characteristics of the various races and people.

(1) Numerous series of objects have been installed to illustrate the progress of culture, such, for example, as the various stages of evolution from stone implements, on the one hand, to the most modern steel tools and engineering appliances on the other. In this work the curator has been ably helped by the veteran Dr. Otis T. Mason, whose writings on technology are so well appreciated by students. An admirable land transport series has been got together, and one hall is devoted to a wonderful collection illustrating transport by water. There is also an interesting section devoted to comparative religions, of which Dr. Cyrus Adler is the custodian. No government in the world does so much for ethnology as does that of the United States.

The Free Museum of Science and Art in Philadelphia contains some very valuable and pleasingly arranged collections of Babylonian, Egyptian and Etruscan antiquities. Good representative collections of American ethnology and archæology are being got together, owing to the exertions of Mr. Culin, the director. Of the special collections given to the university, mention need be made only of the collection of gems, of musical instruments and the Furness-Hose collection from Sarawak. In the museum is also to be found Mr. Culin's very instructive and almost exhaustive collection of games, but unfortunately it is stored away in drawers. If this collection was adequately exhibited it would give to the museum a unique position among anthropological museums.

It is instructive to note that although this is a university museum, no support is received from the university, all the scientific work being prosecuted by funds raised from private sources, a result largely due to the enthusiasm of Dr. Sara Y. Stevenson, the energetic secretary of the department.

In 1869 a little band of public-spirited men was created by the Legislature "a body corporate by the name of 'the American Museum of Natural History,' to be located in the city of New York, for the purpose of establishing and maintaining in said city, a Museum and Library of Natural History; of encouraging and developing the study of natural science; of advancing the general knowledge of kindred subjects, and to that end of furnishing popular instruction and recreation."

A partnership, under sanction of the law, was entered into by the citizens of New York in their corporate capacity with the president and trustees of the museum, it being mutually agreed that the city should pay for the erection of the buildings, their maintenance and protection, while the trustees took upon themselves the responsibility of providing the exhibits, the library, the lectures and other means of instruction and mental recreation. This arrangement is perpetual and irrevocably binding on both parties.

The anthropological department of the museum has accomplished an unprecedented amount of research during the past year, a large sum of money having been received from private sources for the purchase of several important collections of American archæology and ethnology and for the expenses of many expeditions in the field.

The greater part of the anthropological collections in the Yale University Museum are archæological in character. The Peabody Museum of Harvard University is already overcrowded and fresh collections are constantly arriving, which the curator, Prof. F. W. Putnam, is forced to keep in boxes in the storerooms. The main collections are the results of the digging of mounds in the Eastern and Central States; thus the archæology of that portion of America can be very well studied in the museum. During the years 1887 to 1893 the late Mrs. Mary Hemenway provided funds for archæological and ethnological expeditions to the Pueblo Indians of Arizona and New Mexico.

The history of the progress of anthropology in Chicago is eminently characteristic of that typical American city.

There is no need to give a detailed history of the anthropological department of this museum, as Dr. Dorsey has already done so in the American Anthropologist, n.s., ii. 1890, p. 247; but I will briefly indicate the main collections and their origin.

The anthropological collections which formed the foundation of the department were obtained through special expeditions sent out under the direction of Prof. F. W. Putnam, or by collectors resident in the field, who were commissioned by the department of ethnology to undertake the work. A mass of interesting and valuable material from Alaska to Peru was thus accumulated. A few collections from other quarters of the globe were also obtained. The history of the museum since then has been one of almost unparalleled activity. Expedition after expedition has been sent out to collect ethnological and archæological material in North and Central America; some of these have been paid for out of the museum funds, while others have been rendered possible by special donations from benefactors, most of whom are Chicago merchants.

The more technical aspect of the museum has been so well described by Dr. A. B. Meyer that I need not dwell upon it.

The most recent inauguration of anthropological activity is that displayed by the University of California. A department of anthropology was established by the Regents of the University in September, 1901.

As an encouragement to others and as an expression of her great interest in the new department, Mrs. Phœbe A. Hearst, who is one of the Regents and a most generous benefactor to the University, has promised 10,000*l.* (50,000 dollars) a year for five years for anthropological research. In this manner is struck the key-note of the new department. Research first and foremost. We may look forward in the immediate future to the establishment of a really important museum on the Pacific coast which, being under the jurisdiction of the University of California, will be the center of considerable anthropological research and instruction.

Now that the financial position of the Stanford University at Palo Alto is permanently secured, it is to be hoped that the claims of anthropology will not be overlooked.

This is not the place to describe the points of interest in the various museum buildings, the installation of the collections and the details relating to museum administration and technique. It is the less necessary as Dr. A. B. Meyer, of Dresden, who is a recognized authority on all matters pertaining to museums, traveled in the United States in 1899, and he is publishing a series of well-illustrated reports on the institutions he visited. These reports are invaluable to all those who are interested in the promotion or maintenance of museums and libraries, and it is to be hoped that no architect in the future will attempt to draw up plans for a new museum or library until he has consulted this work.*

II. THE TEACHING OF ANTHROPOLOGY IN THE UNITED STATES OF AMERICA.

In America courses of anthropology were established about fifteen years ago at Harvard University and at the University of Pennsylvania. It was one of the first subjects introduced into the curriculum of the University of Chicago. Seven or eight years ago anthropology was recognized in Columbia University in the city of New York. At the present time some thirty-three universities and colleges offer instruction in anthropology. Limit of space precludes my giving details concerning the instruction in anthropology in these numerous institutions, so I confine myself to a consideration of two of the universities where the teaching is most firmly established. Further information on this subject will be found in Prof. G. G. MacCurdy's report on "The Teaching of Anthropology in the United States" in Science, n.s., vol. xv. 1902, p. 211.

It would be impossible to include within the limits of a brief address an account of all the work that is being done in anthropology by the government, by public and private institutions, or by individual effort in the United States of America. Much as I should have liked to have emphasized the interest exhibited in the subject and the wonderful activity that is being displayed, the bare enumeration of all this activity would make a very weary chronicle.

I must confess that I felt a not inconsiderable amount of envy when on every hand I witnessed this energy and then recalled the apathy which pervades our own country.

The American public is more intelligently alive to the interest and importance of anthropology than is our public. The exponents of the science are energetic, enthusiastic and competent, and they succeed in gaining the practical sympathy of wealthy merchants, who are not averse to spending money freely when they see that the money will be wisely spent for the good of the State or of the city. One cannot say that the wealthy Americans are more intelligent than are our rich men, but they do seem to appreciate the value of learning to a much greater extent than do ours. At all events, they respond more readily to the very pressing need there is for the endowment of research and of those institutions which bring the knowledge of the expert down to the comprehension of the masses.

I am quite willing to admit that the fault in this country may lie as much with the specialist as with the capitalist. In any case we have an inspiriting demonstration in the United States of America of what can and should be done in Great and Greater Britain, and I venture to thank our American colleagues in the name of anthropological science for this good example of strenuous effort and praiseworthy accomplishment.

SOUTH AFRICAN COAL FIELDS.

"IT is, perhaps, natural that in the race for wealth in South Africa attention should be largely concentrated upon gold and diamonds, not only because of the handsome profits to be derived from such products of the soil, but also on account of the opportunities for 'making money' afforded by dealings in the shares of companies connected with those branches of mining," says the London Financial News. "Still, it is rather surprising that a comparatively limited interest only is taken in the potentialities of the Transvaal as a coal field. If it were realized that the coal measures of that country are practically inexhaustible; that only enterprise and capital are now needed to convert a relatively small trade into one of world-wide proportions, and that the profits would be very substantial, British investors would provide the funds necessary for the proper exploitation of coal mining as a South African industry. Up to now it can hardly be said to have had the attention its importance deserves. There are, of course, several collieries already at work, but their annual output, considerable as it is, is inadequate to the needs of South Africa itself, while an export trade hardly exists at all. This was, no doubt, due in the past very largely, if not exclusively, to high railway rates, the want of facilities for transport to the coast, and the primitive simplicity of the arrangements at the ports for loading and unloading; but the extensive railway policy which Lord Milner is said to be about to inaugurate will remove all difficulties in the way of bringing down the coal to East London, Durban and Lourenço Marques quickly and cheaply, and the local authorities of those places may be relied upon to provide ample accommodation for storing and proper appliances for transferring it to the ships. There is thus a great opportunity quietly unfolding itself—a lucrative and remunerative industry waiting to be seized by the British investor, who will only have himself to blame if he allows it to be snapped up by the Americans or Germans already on the spot."

Continuing, our contemporary says: "The whole of the East Rand district is literally honeycombed with coal; the seams being of considerable thickness and easily reached from the surface, while the quality is excellent and commands good prices at the gold mines. Of the quantities raised by the existing collieries, complete or detailed records are not available; but the total production of the Transvaal rose from 1,035,121 tons in 1895 to 1,640,486 tons in 1899—not a great increase, it is true, if measured by the developments shown at gold mines in the same period, but one which proves that, with energy, enterprise and capital, the coal industry could be built up to enormous dimensions. The proportion of the output contributed by the East Rand had reached to well over 1,000,000 tons per annum before the outbreak of hostilities in 1899, and yet this coal-bearing area was barely tapped, and the supply was always unequal to the demand. If, therefore, as is anticipated, over 17,000 stamps are to be at work on the Rand within the next five years, and the country is to be overrun by a vast network of new railways, the coal production must advance correspondingly, with substantial benefits to the owners of collieries. But these last will also have to be greatly increased in numbers, and plants of the most up-to-date type will be needed. There is no reason why the whole East Rand should not be dotted with pits. The seams are fairly uniform in thickness, and every description of coal is found—gas, steam and household. The railway freight before the war was, on all lines alike, ½ pence per ton per mile on consignments to the ports, but this rate will probably now be reduced, and, what is even more important, an ample supply of trucks and engines will be provided. Before the war as much as £2 per ton was paid by steamships for the best steam coal delivered at Delagoa bay, and ships were often turned empty away. It would, of course, be too much to expect that this level of prices will be maintained in the future; nevertheless, the requirements of the vastly

* Abridged from the presidential address delivered by Dr. A. C. Haddon, F.R.S., before the Anthropological Institute on January 28. The address is published in full in the current number of the Journal of the Institute.

* The two parts already issued are entitled "Ueber Museen des Ostens der Vereinigten Staaten von Nord Amerika." Reisenstudien von A. B. Meyer. (Berlin: R. Friedlander und Sohn.)

increased fleet of steamers—British, Canadian, American and German—which are now making the voyage to South African ports will alone furnish an extensive and lucrative export trade, and there are also the markets of Aden, Suez and Port Said to be catered for. Combined with the splendid and ever-increasing outlet furnished by the Rand itself, and the greater activity likely to be witnessed in the other mining districts, it will be seen that the coal areas of the East Rand have a future before them little inferior to that of the gold industry and certainly more permanent in its character, for prospectors complain, not without reason, that there is so much coal in this particular region that it hides and obstructs the gold reefs!"

SELECTED FORMULÆ.

Perfumes for Hair Oils.—

I.

Heliotropin	8 grains
Coumarin	1 grain
Oil of orris	1 drop
Oil of rose	15 minims
Oil of bergamot	30 minims

II.

Coumarin	2 grains
Oil of cloves	4 drops
Oil of cassia	4 drops
Oil of lavender flowers	15 minims
Oil of lemon	45 minims
Oil of bergamot	75 minims

—Drug. Cir. and Chem. Gaz.

Tooth Soap.—

Precipitated chalk	160 grammes
Camine (dissolved in ammonia water)	4 grammes
Powdered soap	100 grammes
Peppermint oil	10 grammes
Syrup.	
Glycerin.	
Alcohol, of each a sufficient quantity.	

—Drug. Cir. and Chem. Gaz.

Perfumes for Soap.—The quantities given are sufficient for 5 pounds.

I.

Oil of lavender	½ ounce
Oil of cassia	30 minims

II.

Oil of caraway,
Oil of clove,
Oil of white thyme,
Oil of cassia,
Oil of orange leaf (neroli petit grain),
Oil of lavender, of each, 1½ drachms.

—Drug. Cir. and Chem. Gaz.

Shampoo.—

Ammonium carbonate	1 ounce
Borax	1 ounce
Glycerin	2 ounces
Tincture of quillaja	4 ounces
Bay rum	8 ounces
Rosemary water	4 ounces
Hungary water	16 ounces

—Drug. Cir. and Chem. Gaz.

Laundry Blue Tablets.—

Ultramarine	6 ounces
Sodium carbonate	4 ounces
Glucose	1 ounce
Water a sufficient quantity.	

Make a thick paste, roll into sheets, and cut into tablets.—Drug. Cir. and Chem. Gaz.

Carbon Paper.—A workable substitute for the carbon manifolding paper bought in the stationery stores may be made as follows:

Lard	12 grammes
Beeswax	2 grammes
Lampblack	2 grammes

Melt together the lard and wax, and pour gradually into a warm mortar, containing the lampblack, with constant trituration. Brush this mixture while still liquid over warm paper, and remove the excess with a flannel cloth.—Drug. Cir. and Chem. Gaz.

Leather Polish.—

I.

Sandarac	¼ ounce
Shellac	1 ounce
Glycerin	1½ drachms
Castor oil	2 drachms
Anilin blue	10 grains
Anilin black	1 drachm
Alcohol	8 ounces

Dissolve the resins in the alcohol, add the coloring matter, and finally the glycerin and oil.

II.

Resin	2 drachms
Gum thus	2 drachms
Turpentine	2 drachms
Sandarac	4 drachms
Shellac	1 ounce
Alcohol	7½ ounces
Lampblack	1 drachm

Dissolve all but the pigment in the alcohol, filter and add the lampblack. Instead of lampblack, zinc white, ultramarine blue or other similar coloring may be used. This is said to be elastic and unbreakable.—Drug. Cir. and Chem. Gaz.

"Gold Luster" for Porcelain Decoration.—It is said that a brilliant yellow color known as "gold luster" may be produced on porcelain by the use of paint prepared as follows: Melt over a sand bath 30 parts of rosin, add 10 parts of uranic nitrate, and, while constantly stirring, incorporate with the liquid 35 to 40 parts of oil of lavender. After the mixture has become entirely homogeneous, remove the source of heat, and add 30 to 40 parts more of oil of lavender. Intimately mix the mass thus obtained, with a like quantity of bismuth glass prepared by fusing together equal parts of oxide of bismuth and crystallized boric acid. The paint is, of course, to be "burned in" in the usual manner.—Drug. Cir. and Chem. Gaz.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Importation of Cattle Into Cuba.—Minister H. G. Squiers transmits from Habana, September 17, 1902, translation of the law in regard to the importation of cattle, as finally passed.* The text follows:

DEPARTMENT OF AGRICULTURE, INDUSTRIES, AND COMMERCE.

Be it known by these presents, that the Congress has voted, and I, Tomas Estrada Palma, Constitutional President of the Republic of Cuba, have sanctioned, the following law:

Article 1.

The following schedule will govern for the collection of tariff duties on cattle, horses, and sheep imported into this island through any of the ports of entry, and such others as the Executive may deem advisable to create:

Ewes	Free.
Cows (suitable for breeding) and calves	Free.
Cows, with their calves	Free.
Jersey, Guernsey, Devonshire, Durham, Hereford, Porto Rican, and Argentine Republic bulls, provided they are duly proven to be such	Free.

Article 2.

Yearlings will pay	per head	†$1
Florida male cattle, fat—fat being understood as exceeding 500 pounds (253 kilograms) in weight—will pay	per head	5
Honduras male cattle, fat—fat being understood as exceeding 600 pounds (276 kilograms) in weight—will pay	per head	6
Mexican male cattle, fat—fat being understood as exceeding 700 pounds (323 kilograms) in weight—will pay	per head	7
Venezuelan and Colombian male cattle, or those of other countries than those mentioned, fat—fat being understood as exceeding 800 pounds (368 kilograms) in weight will pay	per head	8
Lean cattle—that is, such cattle as do not weigh as much as the weights specified according to the place from where they come—will pay	per head	2

Article 3.

No lean cattle will be slaughtered until at least three months after their landing. To this end, they will be branded on entering the island's ports with an iron or brand indicating the date of importation and that they are for pasture. Before any of the cattle bearing the brand referred to can be slaughtered, it must be proven, in the manner which may be established, that they have been in pasture for the period of three months referred to.

Article 4.

The slaughter of female cattle is prohibited, such as may be useless for breeding and properly proven to be so, excepted.

Article 5.

Stallions, whose height exceeds that established (150 centimeters, or 59 inches, measured by rule), and jackasses, whose height exceeds 130 centimeters, or 51 inches (measured in the same manner), will enter free of duty.

Article 6.

Mares suitable for breeding will pay	per head	$3
Mares not comprised in the preceding case will pay	do	15
Geldings whose height exceeds that referred to will pay	do	15
Geldings of lesser height will pay	do	2
She mules whose height exceeds that established will pay	do	10
She mules of lesser height will pay	do	5

Article 7.

The exportation of cattle is prohibited.

Article 8.

Neither the State, the province, nor the municipality will establish direct taxes or consumption taxes on the products of our cattle industry without establishing the same taxes, in like form and amount, on the products of the foreign-cattle industry. In whatever manner meat, national or foreign, is placed on the market, it will be considered as one single product for the purpose of levying taxes previously cited.

Article 9.

Barbed wire and staples used in building fences are exempted from the payment of tariff duties.

Article 10.

This law will take effect ten days after its publication in the Gazette.

Article 11.

The Government will issue the orders, decrees, and regulations for the carrying out of this law.

Article 12.

Such former rulings as are contrary to the provisions of this law are revoked; therefore, I command its obedience and enforcement in its entirety.

Given at the palace of the President, in Habana, on September 15, 1902.

T. ESTRADA PALMA.

MANUEL L. DIAZ,
Acting Secretary of Agriculture, Industries, and Commerce.

Fraudulent Land Schemes in Cuba.—Consul-General E. S. Bragg reports from Habana, under date of September 30, 1902, in regard to an enterprise said to have been organized in the United States, with the object of selling land to farmers desirous of migrating to Cuba. The company has sent out a large number of circulars, describing the land as situated in the province of Santa Clara, on the Zapata Peninsula. Steamers are advertised as running from the small port of Batabano, in the province of Habana, to the Bay of Cochinos, in Santa Clara. Mr. Bragg explains that no such line of steamers exists, for two reasons—lack of water and lack of trade. Zapata Peninsula is largely a swamp, described in the report of the census of Cuba (1899), made by Lieutenant Colonel Sanger, as "an almost impenetrable region, 75 miles in length, with a maximum breadth of fully 30 miles" (p. 18).

The geographical description of this swamp and its inhabitants will be found on pages 649 and 658 of the report. The following quotations are made:

On the southern coast we find the famous swamp of Zapata, very extensive and dangerous, extending from the Bay of La Broa to Caimanera. . . . It is only possible to enter the swamp by the southern coast by two or three very shallow ports, the principal one being that of the estate of Santa Teresa, called to-day La Maquina. By the northern coast, it may be said that there exists only one entrance to the swamp in the province of Santa Clara. . . . In order to reach this pass there are only four practicable roads. . . . To go through these entrances on horseback, it is necessary to wrap the horses from their heads to their knees with pieces of hard leather, in order to prevent them injuring themselves against the points of the coral, called "dog's teeth," and so that they may endure the journey, which, by reason of the nature of the ground, is necessarily slow and arduous, as well as very unpleasant, on account of the numerous mosquitoes in the swamp. . . . For the men, it is necessary to carry provisions along, because the natives (who are the only ones who can live there) live exclusively on crocodile tails, mud turtles, agouti (Indian rats), and honey. To feed the horses, it is necessary to cut leaves from the trees.

German Tariff on Machinery.—The present German tariff rates on foreign-made machinery are easy to calculate. Locomotives and portable machines pay a duty at the rate of 8 marks ($1.90) per metric centner (220.46 pounds); the duty payable on other machines depends upon the material which predominates; if chiefly of wood, 3 marks (71 cents) per metric centner; of cast iron, 3 marks (71 cents) per metric centner; of malleable iron, 5 marks ($1.19) per metric centner; of other metal, 8 marks ($1.90) per metric centner. These are now to be superseded by a complicated arrangement of various "progressive rates," dependent upon weight. Thus, we find that locomotives weighing up to 10 tons are to pay 11 marks ($2.62) per metric centner; those weighing over 10 tons, 9 marks ($2.14); locomotive tenders, 5 marks ($1.19); engines, motors, from 3 marks 50 pfennigs up to 100 marks (83 cents to $23.80) per metric centner; sewing and knitting machines without frames, 35 marks ($8.33); with frames, 20 marks ($4.76); curtain, lace, and tulle machines, 10 marks ($2.38); machines for working metals, wood, and stones, 4 to 20 marks (95 cents to $4.76); steam mowing and threshing machines, 9 marks ($2.14); spinning and weaving machines, 6 marks ($1.43); other machines according to weight, from 3.50 to 18 marks (83 cents to $4.28); electrotechnical products, 6 to 60 marks ($1.43 to $14.28); incandescent lamps, 120 marks ($28.56); vehicles for rails, 5 to 12 marks ($1.19 to $2.86); other vehicles, 20 to 150 marks ($4.76 to $35.70); and bicycles, 150 marks ($35.70) per metric centner. It can be easily seen how hard it will be to have these rates applied uniformly in view of the latitude allowed to the appraising officials.—Oliver J. D. Hughes, Consul-General at Coburg.

Demand for American Textiles in Amsterdam.—Consul F. D. Hill sends from Amsterdam, August 29, 1902, copy of a letter from Mr. J. H. M. van Ogtrop, a merchant of that city, as follows:

I should very much like to represent an American textile firm willing to do business in Holland and Belgium. For a long time there has been a good demand for American makes, chiefly in woven fancies, linings, sateens, drills, and prints. Authorities in textiles are of opinion that within a short time America will oust the English market. However, there will never be a chance if America wants to do business on cash terms. As is generally known, the accounts in Holland and Belgium are fairly safe, but the quickest payment that can be desired is on thirty-day terms. In this case, it would be an easy thing for American firms to find a good class of customers. If any of your friends would like to be represented, I beg to offer my services as a well-known and pushing agent.

Bulawayo-Cape Town Railway Service.—Acting Consul W. C. Magelssen, of Beirut, under date of August 26, 1902, notes as a supplement to Consul Ravndal's report on the Cape to Cairo Railway, of May 10 last, that, according to telegraphic information, the first train de luxe from Bulawayo arrived at Cape Town August 13, having completed the journey in seventy-four hours. The train will run once each way weekly.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

* See Advance Sheets No. 1409 (August 4, 1902); Consular Reports No. 264 (September, 1902).

† Paid in United States gold or its equivalent.

TRADE NOTES AND RECIPES.

Furniture Polish.—Some one of the following may serve.

I.

Shellac	4 parts
Alcohol	32 parts
Oil of turpentine	16 parts
Linseed oil, boiled	32 parts
Ammonia water	4 parts

Dissolve the shellac in the alcohol; dissolve, in a separate vessel, the linseed oil in the turpentine and mix the two solutions, adding them slowly with continuous agitation; then add the ammonia water and mix by agitation until thoroughly homogeneous.

II.

Yellow wax	8 parts
Yellow soap	1 part
Oil of turpentine	16 parts
Boiling water	16 parts

Melt the soap and wax over a slow fire, add the turpentine, and stir in the water until quite cold.

III.

A so-called polish which is more a varnish is made as follows:

Shellac, best quality orange	1000 parts
Rosin	65 parts
Venice turpentine	200 parts
Alcohol	2600 parts

Mix and put in a warm place, agitating frequently until the resins are dissolved. Let stand until limpid, then decant the clear fluid.

IV.

Mastic	65 parts
Shellac	250 parts
Alcohol, 95 per cent	1000 parts

V.

Paraffin wax	7 ounces
Petroleum jelly	2 ounces
Solution of potassa	5 drachms
Yellow wax	3 ounces
Alkanet root	1 ounce
Turpentine	12 ounces

Place the first four ingredients in a vessel and melt with gentle heat, then add the others, digest an hour and strain.

VI.

Mix one part of old boiled linseed oil with 2 parts of an alcoholic solution of shellac. Agitate each time before using, and apply in small quantities, rubbing vigorously until the polish is attained.

VII.

It has been said by the Färber Zeitung that a certain "oily sweating" of articles of polished wood occurs which has been ascribed to the oil used in polishing, but has been found to be due to a waxy substance present in shellac, which is often used in polishing. During the operation of polishing, this wax enters into close combination with the oil, forming a soft, greasy mass, which prevents the varnish from ever becoming really hard. This greasy matter exudes in the course of time. The remedy, therefore, is to use no shellac until the vegetable wax in it has been completely removed. This is accomplished by making a strong solution of the shellac in alcohol and then shaking it up with fresh seed lac or filtering it through seed lac. In this way the readily soluble resins in the seed lac are dissolved, and with them traces of coloring matter. At the same time the vegetable wax, which is only slightly soluble, is deposited. The shellac solution which has exchanged its vegetable wax for resin is not yet suitable for fine furniture polishing. It is not sufficiently taken up by the wood, and an essential oil must be added to give it the necessary properties; one of the best oils to employ for this purpose being that of rosemary. The following recipe is given: 20 pounds of shellac and 4 pounds of benzoin are dissolved in the smallest possible quantity of alcohol, together with 1 pound of rosemary oil. The solution then obtained is filtered through seed lac so as to remove whatever vegetable wax may be present.—Drug. Cir. and Chem. Gaz.

Receipt for Silver Metal.—A writer in the Aluminium World gives the constituents of a hard alloy which has been found very useful for the operating levers of certain machines. The spacing lever of a typewriter is constantly handled when in use, and if made of iron or steel and nickel plated, even heavily, the plating soon wears off, leaving the metal underneath exposed to rust and corrosion, a condition which, of course, is not permissible. If the levers are made of brass the matter is not helped to any extent, as the plating wears off the same as iron or steel and leaves the brass exposed which is, if anything, more objectionable than iron or steel. The metal now generally used for this purpose by the various typewriter companies is "aluminium silver," or "silver metal." The proportions are given as follows:

Copper	57.00
Nickel	20.00
Zinc	20.00
Aluminium	3.00
	100.00

This alloy when used on typewriting machines is nickel-plated for the sake of the first appearance, but so far as corrosion is concerned, nickeling is unnecessary. In regard to its other qualities, they are of a character that recommends the alloy for many purposes. It is stiff and strong and cannot be bent to any extent without breaking, especially if the percentage of aluminium is increased to 3.5 per cent; it casts free from pinholes and blowholes; the liquid metal completely fills the mold, giving sharp, clean castings, true to pattern; its cost is not greater than brass; its color is silver white; and its hardness makes it susceptible of a high polish.

To Prepare Resin for soldering bright tin, mix 1½ pounds of olive oil, 1½ pounds of tallow and 12 ounces of pulverized resin, and let them boil up. When this mixture has become cool add 1⅝ pints of water saturated with pulverized sal-ammoniac, stirring constantly.—Mining and Scientific Press.

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